CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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A REVIEW OF THE KELP INDUSTRY.

By W. C. CRANDALL.

In the year 1910, the Bureau of Soils of the United States Department of Agriculture, called the attention of the public to the giant kelps lining much of the west coast of America. New requirements for fertilizers and an extending market had caused the Bureau of Soils to look for other sources of supply, and from information at hand at that time, it seemed that the giant kelps might prove to be such a source. More intensive study of the plant and the extent of its distribution confirmed the idea, and consequently a great industry is being developed.

The giant kelps along the coast of California are of these general types. The one more widely distributed and greatest in quantity is the *Macrocystis pyrifera* or ribbon-kelp. Plants of this species varying

from 25 to 100 feet in depth below the water, are found in beds along the shore where rocky ledges or loose rocks abound and to which the plants attach themselves by means of holdfasts. These beds occur usually in exposed places where the wave action is pronounced.

The plant itself consists of a holdfast or root-like structure which attaches itself to rocks at the bottom; stipes or stems, unbranched, which grow up from this holdfast until they, sooner or later, reach and spread out upon the surface of the water; and lamina or leaves which occur at intervals along the stipes, the intervals varying from 2 to 3 feet near the holdfast to a slight space near the growing end. The terminal leaf of the growing stem splits, a new terminal leaf forms and splits, and as the process continues, lamina along the stipe are increased; while by the elongation of the distance between lamina the total length of the stipe is increased.

The plant reproduces itself by means of spores which are developed in spore bodies located, usually, on leaves near the holdfast, although they are occasionally found on leaves near the tip of the plant. In this regard, Dr. R. P. Brandt, Botanist of the Scripps Institution, will soon be ready to publish some interesting observations made by him in his recent studies of *Macrocystis pyrifera.*

The beds of *Macrocystis* with which the California kelp industry is concerned extend along the coast from San Diego to Point Concepcion and about the islands offshore. During the last year the beds from San Diego to San Juan Point and about San Clemente, San Nicholas and Santa Barbara Islands were used by the Hercules Company, Swift & Company, and numerous handpickers; the beds about Long Beach and Wilmington were used by the Diamond Match Company, the Pacific Products Company, and the Sea Products Company; while in the Summerland region, the United States Experimental Plant, the Lorned Manufacturing Company, and the California Chemical Company were operating. The total amount of kelp used during the year was nearly 400,000 tons wet, the amount of potash (K_2O) per ton averaging about 1.5 per cent. With this were considerable quantities of iodine, nitrogen, and other by-products such as acetones and ketones.

The kelp is cut by harvesters which are very similar to grain-reapers, the notable feature being that reciprocals cut the plants 2 or 4 feet below the surface and the cut kelp is then carried up over the draper and deposited on the barge. Its treatment then varies according to whether it is to go through the "wet" or the "dry" process. Sometimes it is ground fine; sometimes it is cut into short lengths; and sometimes it is left in long strands. At the factory the kelp may be dried in large rotary driers, ground and made into fertilizer; or dried, incinerated, and then made into fertilizer; or, again, mixed with certain chemicals, permitted to ferment, and then broken up into different products by the processes of evaporation, crystallization, and fractionalization.

The last legislature placed the control of the kelp beds in the hands of the State Fish and Game Commission, and the scientific study of the plant in the hands of the Scripps Institution for Biological Research of

the University of California. At the same time, a tax of 1½ cents per wet ton was levied, and a license, costing a fee of $10.00, was demanded of every company harvesting kelp. As soon as the Fish and Game Commission assumed control, the beds were numbered consecutively from San Diego along the coast to Point Concepcion and thence about the islands, and, in order that after being harvested a bed should have sufficient time to recuperate, usually about ninety days being required, a system of opening and closing of beds was worked out. This measure not only protects the bed from depletion, but assures the

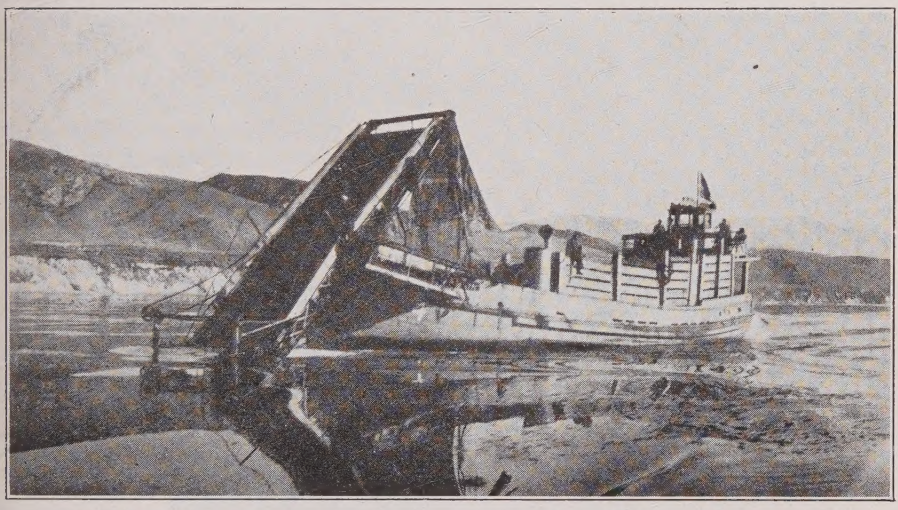

Fig. 56. Power kelp harvester at work off coast of southern California. Photographed by Edward E. Porteous.

maximum crop. The beds off Santa Barbara were closed for the use of the United States Kelp Experimental Plant. In opening the other beds, it was arranged so that the harvesting would not interfere with the beaches during the summer season, nor with unprotected beaches during the winter, it being the intention of those concerned to regulate the harvesting of kelp with as little inconvenience as possible to neighboring communities.

What effect the harvesting of kelp has on the fishing industry has been carefully studied by the U. S. Bureau of Fisheries, by the Scripps Institution and by many fishermen, and no injurious effect has been apparent as no fish eggs are found attached to the upper portion of the kelp plant and only this upper portion is cut. However, kelp-harvesters and fishing-gear in the same bed are not good companions, to say the least, and better co-ordination between the two industries represented is being planned.

THE GROWTH OF KELP.

By EDWARD PORTEOUS.

Studies of the life history and growth of kelp *Macrocystis pyrifera* are most fascinating, but this phase of the kelp problem has received very little attention from the industries dependent upon it. These, seemingly content with the fact that it does replace itself in time, have left the working out of its phases, environment, reproduction and growth to those scientifically inclined, who, in turn, look at it from an entirely different aspect from the manufacturer who is so dependent upon the plant as his source of revenue.

The harvesting of kelp over comparatively large areas has given some small insight into the life of the plant. This knowledge undoubtedly could be greatly increased if the state could appoint someone to take up this and many of the other problems connected with the comparatively new industry.

After the harvester has cut a bed clean, to the depth of four feet, the old kelp may be seen standing in an upright position with its growing ends cut off, looking not unlike a poplar tree. The kelp thus cut gradually lightens in color and appears to disintegrate and gradually disappear. This disintegration seems to start from the cut end and extend downward toward the holdfast, but usually before it has entirely disappeared from view it is hidden by the fresh shoots coming up from the rizomes.

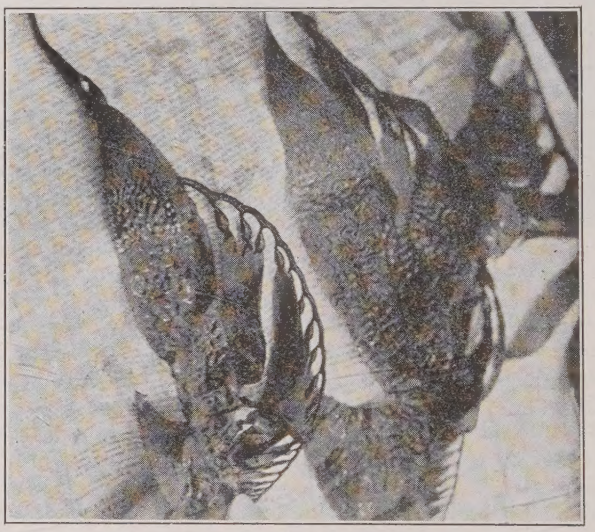

Fig. 57. Growing ends of kelp (*Macrocystis pyrifera*). Photograph by Edward E. Porteous.

Variation in the character of a bed is often noticed. Bed No. 24 in 1916 showed unmistakable "lanes" of water or clear places, looking not unlike "roads" left by the harvesters; but examination showed no plants beneath the surface. These long lanes of clear water, which

were devoid of kelp, were about ten to twelve feet in width and were parallel to each other, and as a whole parallel to the trend of the coast. Two explanations of the phenomenon can be given: First, this condition might have been caused by the covering up of portions of the rocks to which the plant attaches its holdfast by the "sand waves" caused by the meeting of two currents, one from Santa Monica Bay, flowing southward, and the eddy current, near the shore, flowing northward. Second, geologically the land adjacent to this bed belongs to the Quaternary system, which all shows more or less deformation. The power of the sea which is derived chiefly from the winds, makes an effective eroding agent, and, since the land resists erosion, according to the coherence of the rock masses, the harder offering more resistance and the softer being moved by the onrush of the waves along the beach in the direction of the heaviest storms or prevailing winds, that which is fine enough is taken up by the water and deposited in quieter regions beyond the action of the waves. Owing to the deformation of the stratification of the land, and the upturned hard strata, following the configuration of the deposition, would present long, comparatively flat, parallel ridges upon which the plant might attach itself, while the "valleys" or softer portions between the harder strata, would be of such a nature that the plants, if attached, would break away, and thus leave voids in the continuation of the beds.

Another idiosyncracy of the same bed, which can be explained more easily by the first speculation given above, is seen in the fact that the following year these "waterlanes" had entirely disappeared and in their stead there had appeared a large oval-shaped clear patch, apparently devoid of kelp. This was a little farther northward and closer in shore, but it possessed the same general trend on its longer diameter as the "waterlanes." Undoubtedly the changes of the current had deposited a sort of "bar" of sand, which covered up the holdfasts, and the harvesters having cut their growing ends thus destroyed the plants in this area.

A noticeable fact in the growth of kelp is that the leaves are much longer and broader and the stipe or stem heavier and thicker in the kelp on the surface than is the case with the kelp that is always beneath the surface. Once on the surface the growth is greater, owing to the plant now being able by photosynthesis to build up plant material. The cells admitting the penetration of the various salts held in solution, more especially the potash, stimulate nuclear division, and cause the leaf to expand and likewise increase in weight. No doubt growth is aided by osmotic pressure also, as well as by the influence of the sun's rays.

Since all matter absorbed by the plants must pass through the cell wall, and since no solid material can be taken up as nutriment, the food, on entering the cell walls, must be either in a liquid or gaseous state. The cells not only allow the entrance of a fluid, but also some of the substances held in the solution. This free path of a solution, having crystalloids in suspension, is of vital importance in the upbuilding of the plant, and incidentally in the maintenance of a potash plant or factory, for without this tiny cell's power to absorb the potash from the ocean, America would be dependent upon the Strassfurt and various smaller deposits of crude salts, as before.

It follows that if a solution can enter into the cell, it would have first to pass through the protoplasm by way of the cell's wall; but living protoplasm, unlike its walls, gives permeability to all substances in solution in varying amounts, segregating certain crystalloidal bodies from others, according to conditions. This power of decision is not entirely limited to the outer protoplastic covering or membrane. The vacuole's wall has a similar distinction in its selective ability, and this selective power is so much greater than the osmotic pressures bearing on the cells that they often show great variation in chemical constituents and quantities to their surrounding medium. It seems remarkable that this medium containing three per cent of chloride of sodium, four one-hundredths of one per cent potash, and with the proportion of iodine so small that it requires more than 30,000,000 pounds of the sea water to furnish the kelp with one single pound of iodine, that we find that the cells of some of the plants select one and eight one-hundredths per cent potash, six-tenths of one per cent sodium, and three one-hundredths of one per cent iodine, in their fresh and natural state. These small

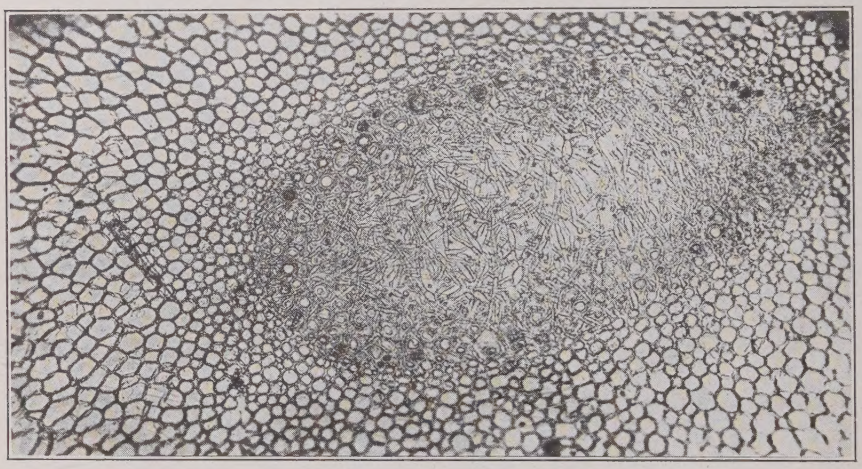

Fig. 58. Cross section of stem of kelp greatly enlarged, × 400. Photograph by Edward E. Porteous.

elementary substances are large when compared to the quantity of metals the sea holds in solution, and upon which the seaweed has some absorptive power. In the case of gold there is about one grain in every ton of sea water, yet kelp has been known to absorb twenty cents worth of this precious metal to the ton of green kelp. In the case of silver, there is about one grain to every six tons of sea water; but so far, except in the case of *Pocillopora alciconis*, analyses have not shown silver in the plants. Of the lesser metals, no doubt traces may be found. However, very little work has been expended in this direction.

The rate of growth and the growing period, or seasonal growth, are still mooted questions. While it is believed that kelp grows all the time, it appears that there are periods when the growth is more luxuriant. At least, this is borne out in the following observations. On bed No. 21, which undoubtedly has been cut over more than any single bed on the coast, and one which the writer has had under observation

for three years, we find there are two main growing periods about six months apart; the larger and better growth of the two being from July to September, the other one January to April, the winter period requiring a little longer, owing to cloudy weather. Dark days retard growth, while bright sunny days accelerate it, no doubt aided by the water being more or less obscured by the sand and silt from the rainy season and storms that agitate the shore line.

After the growing end is destroyed, or cut off, it takes about 170 to 180 days for the kelp to grow from the holdfast to the surface (the mean depth of bed No. 21 being seven fathoms). There is a constant growth of fresh shoots, about four to six feet under the cuttings, which can best be seen after a bed is cut over. If the cutters had cut lower than four feet under the surface of the water these shoots would have been destroyed and thus the appearance of the kelp on the surface would have been delayed. This same appearance of young kelp on a cut over bed can also be noticed on portions of bed No. 24, which owing to its greater variation in depth, is not as uniform in its fresh growth as the former bed.

A ten-foot length, floating on the surface at a falling tide was measured back under water to a depth of ten feet and cut in the endeavor to find the maximum number of leaves and their lengths on this twenty foot cutting. The results were as follows:

1st foot from growing end, 9 leaves, weighed 1 oz., longest leaf 12 inches and the diameter of the stipe just back of the splitting area was 3/32 inches
4th foot from growing end 5 leaves, weighed 3 oz., longest leaf 17 inches
5th foot from growing end 5 leaves, weighed 3 oz., longest leaf 19 inches
6th foot from growing end 5 leaves, weighed 3 oz., longest leaf 19 inches
7th foot from growing end 5 leaves, weighed 3+ oz., longest leaf 19 inches
8th foot from growing end 5 leaves, weighed 3¼ oz., longest leaf 19½ inches
9th foot from growing end 5 leaves, weighed 3½ oz., longest leaf 19½ inches
10th foot from growing end 5 leaves, weighed 3¾ oz., longest leaf 19½ inches
11th foot from growing end 4 leaves, weighed 3 oz., longest leaf 19½ inches
12th foot from growing end 5 leaves, weighed 3½ oz., longest leaf 20 inches
13th foot from growing end 4 leaves, weighed 2¾ oz., longest leaf 18 inches
14th foot from growing end 4 leaves, weighed 2¾ oz., longest leaf 18 inches
15th foot from growing end 4 leaves, weighed 2¾ oz., longest leaf 18½ inches
16th foot from growing end 3 leaves, weighed 2 oz., longest leaf 18½ inches
17th foot from growing end 4 leaves, weighed 2¼ oz., longest leaf 18½ inches
18th foot from growing end 3 leaves, weighed 2 oz., longest leaf 18½ inches
19th foot from growing end 3 leaves, weighed 2 oz., longest leaf 19 inches
20th foot from growing end 3 leaves, weighed 2 oz., longest leaf 20 inches

The diameter of the last foot of stipe was 9/32 of an inch. Plotting the above figures, we find that there is a wide discrepancy between the weight and the number of leaves up to the third foot. From here on, while the number of leaves per foot remains constant up to the tenth foot, the weight gradually increases up to the same division. From here on, the variation is very small; at the seventeenth foot the weight falls a little lower than the general average, the tenth foot marking the nodal point, from which on one hand, the growing end, the number of leaves and the weight per foot gradually approach from nothing, to about the fourth foot, where the number of leaves per foot remain constant up to the ten-foot or nodal point. From this point toward the holdfast, weights and numbers of leaves have about the same constant, rising and falling in unison.

The maximum number of leaves is at or near the third foot; while the greatest weight per foot is at the tenth. The size of the stipe follows

a close ratio to the width of the leaves; while, strange to say, the ratio between the length of the leaves and the weight, after the tenth or twelfth foot falls away. This, of course, can easily be explained by the fact that the number of leaves also decreases.

The weights and sizes of leaves of a section of kelp measuring forty-five feet were as follows:

1st 5-foot length	15 oz.,	largest leaf	20x4	inches,	stipe diameter	8/32,	40 leaves
4th 5-foot length	32 oz.,	largest leaf	24x4¾	inches,	stipe diameter	12/32,	28 leaves
5th 5-foot length	20 oz.,	largest leaf	25x4½	inches,	stipe diameter	10/32,	19 leaves
6th 5-foot length	13 oz.,	largest leaf	26x4	inches,	stipe diameter	9/32,	15 leaves
7th 5-foot length	8 oz.,	largest leaf	25x4	inches,	stipe diameter	8/32,	10 leaves
8th 5-foot length	5 oz.,	largest leaf	18x3	inches,	stipe diameter	8/32,	8 leaves
9th 5-foot length	3 oz.,	largest leaf	18x2¾	inches,	stipe diameter	8/32,	5 leaves

The third to fifth foot shows the most rapid changes in growth. Up to this point the plant as a whole develops in the same ratio. The most even tenor of the plant's life as far as growth is concerned is found between the fifth foot and that portion which just enters the water toward the holdfast; in other words it is in that floating portion on the surface of the water, and that portion of the plant just below the tidal influence, that the most rapid changes take place in the number of leaves and the weight per foot. The length of the leaf remains fairly constant until such a part is reached that, owing to the more or less transparent condition of the water, the natural growth of the leaf is affected.

The above measurements and weights are given simply as examples of growing kelp, and really are not sufficient in number nor collected from enough different areas or seasons of the year to arrive at a general conclusion.

ENEMIES OF KELP.

Now that we are utilizing kelp both as a source of revenue and as a raw material for manufacturing a commodity, we are jealous of the various forms of life that live upon the seaweed. Some are quite harmless in their habits; others more destructive, from our point of view.

A large trochid which feeds upon the kelp, although consuming such a small amount as to be negligible, yet clings to the plants in such great numbers at certain seasons of the year that it greatly affects the calcium content of the output. Some beds of kelp are more affected than others. Another calcareous tube worker, the *Spirorbis borealis,* easily mistaken for a small shell, is found sometimes so thick as to give the kelp leaves a bleached appearance, literally covering both sides of the fronds and extending over quite large areas, increasing the weight forty per cent. The *Trochiscus norrisi* mentioned above is very much heavier in proportion to the *Spirorbis,* but their number luckily is not as great, a square centimeter of the frond holding sixty to seventy *Spirorbis. Flustra membranacea,* a polyzoan, forming a gauze-like incrustation on the leaves and stipe and occupying irregular patches, sometimes nearly covering the whole frond, also increases the calcium percentage. These and many others, although in a lesser capacity, more or less affect the general chemical constituents of the plant.

So far only one gastropod, an acmæa, has been found to be really destructive to kelp. It really prefers an *Egregia* plant to a *Macrocystis,* but it is not above devouring the stipe to such dangerous proportions that it breaks off and is cast adrift at the first heavy swell or storm that passes.

THE MUSSELS OF THE PACIFIC COAST.*

By EDWARD P. RANKIN.

To most of those who have spent any time on the seashore, the mussels, clustered in balloon-shaped masses on the pilings of wharves or scattered in irregular groups on the rocks, are a familiar sight. It is the purpose of this paper to make these mussels more widely known, to introduce them to those people who have had no opportunity to make their acquaintance at first hand, and to make them, if possible, more interesting to those who have met them already.

We have, on the Pacific coast, two species of mussel: a small one, *Mytilus edulis,* and a large one, *M. californianus.* The latter-named

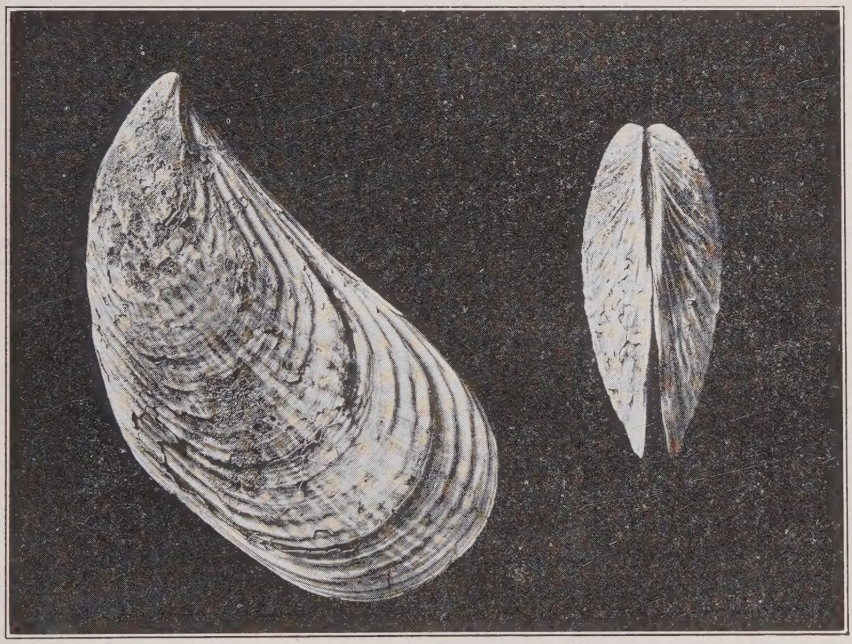

Fig. 59. Two common species of mussels found in California. Left, *Mytilus californianus,* a large form found along the entire coast; right, *Mytilus edulis,* a smaller variety restricted more largely to inlets and bays. Photograph by W. C. Mathews.

species, which can attain a length of ten inches, is known from Socorro Island (in the Revilla Gigedo group, about 250 miles south of Lower California) to Alaska; its shell has both radial and concentric markings, and varies in color from light brown to dark purple. This mussel likes the salt water of the open coast, where it clings to reefs and wharves. *M. edulis* rarely exceeds three inches in length and has a shell that is smoother (lacking the radial lines) and darker than that of *californianus.* It ranges from San Diego northward and prefers the more sheltered and brackish waters of inlets and bays such as San Diego Bay and San Francisco Bay.

*Printed by permission of the United States Bureau of Fisheries.

In structure the two species are very similar. Externally, there is the bivalve-shell, narrowed to the *umbo* or "beak" at the anterior end, and hinged at the "back" or dorsum by an elastic piece of cartilage-like substance that tends to pull the shell open (see fig. 60). Internally, the shell is lined with a membrane, called the *mantle,* for the protection of the animal within; the mantle bears the shell-forming glands that serve both to add to the size of the shell and to repair breaks (see fig. 61). During most of the year the mantle is a very thin-looking tissue indeed, but in the spawning-season it becomes greatly thickened and swollen by the eggs or the milt. On each side, between the mantle and the "body" of the animal are the gills, two layers of extremely delicate tissue; they can be distinguished from the mantle by reason of the very fine longitudinal lines which mark them.

Fig. 60. Exterior of California mussel. Photograph by W. C. Mathews.

The "body" contains the digestive tract and bears the foot. In an opened mussel, one can see, at the anterior end, four leaf-like pieces of tissue growing out from around a slit-like opening; this opening is the mouth or labium, and the pieces of tissue surrounding it are the labial palps, which by their motion help to direct the food into the mouth. The remainder of the digestive tract is rather difficult to trace; its course will be merely outlined. From the mouth the food passes into the gullet, forward of the foot, and then into the stomach, which lies in a mass of dark-colored tissue, the so-called liver; the intestine passes back to the big posterior adductor muscle, around which it bends, then passes forward to the heart and back again to the muscle already referred to. Like other molluscs, the mussel has a closed circulatory system, with heart and blood vessels; it has also a very simple and primitive nervous system. The tongue-like foot is the organ of locomotion during the juvenile period; it contains the byssus gland, which will be referred to more fully farther on.

Finally, there are three sets of muscles which can be found more or less readily. First, there are the adductor muscles with which the animal closes his shell; one of these, the posterior adductor, is the large muscle which must be cut before the shell can be opened; the other, the anterior adductor, is a small muscle at the anterior end. Then there are the muscles which protrude and retract the foot; these are fastened "fore and aft," some of them lying parallel to the hinge; the outlines of the posterior retractors are shown in the photograph (fig. 61). Lastly, the fine pallial muscles serve to attach the mantle edge to the shell.

When the soft parts have been removed, one can see, on the inside of the shell, the "scar" where the posterior adductor muscle was attached, and the pallial line which marks the region of the edge of the mantle.

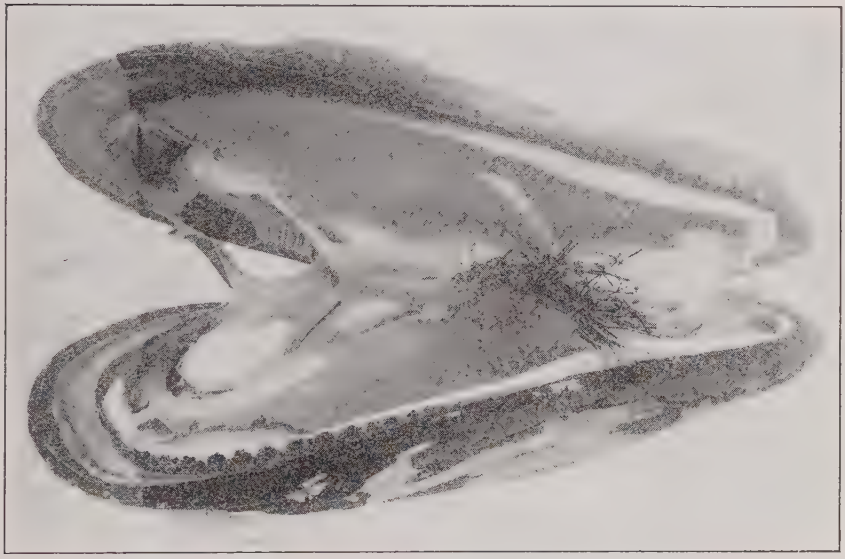

Fig. 61. Interior of California mussel showing body structure. Photograph by W. C. Mathews.

It is not yet known when the Pacific coast mussels spawn. Dealers believe that spawning takes place as early as April or May, but at San Diego, in 1917, the mussels certainly were not in spawning condition before the latter part of July. However that may be, the resulting young mollusks are able to swim about within a very few hours. They continue to be free swimming (or, to express it more explicitly, they are carried about by the tital currents) for about four or five days. At any rate, this is what Dr. Field (1909) reports for the Atlantic coast mussels, and it is likely that ours behave in much the same fashion.* The young then grow a shell, begin crawling over solid objects by means of the foot, and at last attach themselves to something solid. The attaching threads, constituting the *byssus*, or "beard," are produced by the byssus gland previously mentioned. These threads are

*Field, Irving A. 1909. Food value of sea mussels. Bull. U. S. Bureau of Fisheries, vol. 29, pp. 85-128.

probably of a glue-like consistency at first, but harden into the firm, stiff fibers which hold the mussel so securely to his perch.

From now on, the mussels are practically settled for life; doubtless they can shift about in a very limited area on the object to which they are fastened, but their days of "roving" are ended.

Owing to the precariousness of their existence, of the countless numbers of young that are produced each season comparatively few live to maturity and to "ripe old age." At the beginning, many probably fall prey to small fishes and to other carnivorous creatures; many doubtless succumb to the lack of food, while still others may fail to find suitable places for attachment. Those that succeed in becoming fixed are still exposed to attacks from carnivorous inhabitants of the sea. Their worst enemy on the Pacific coast is the starfish, which has been known to destroy immense mussel beds in a short time.

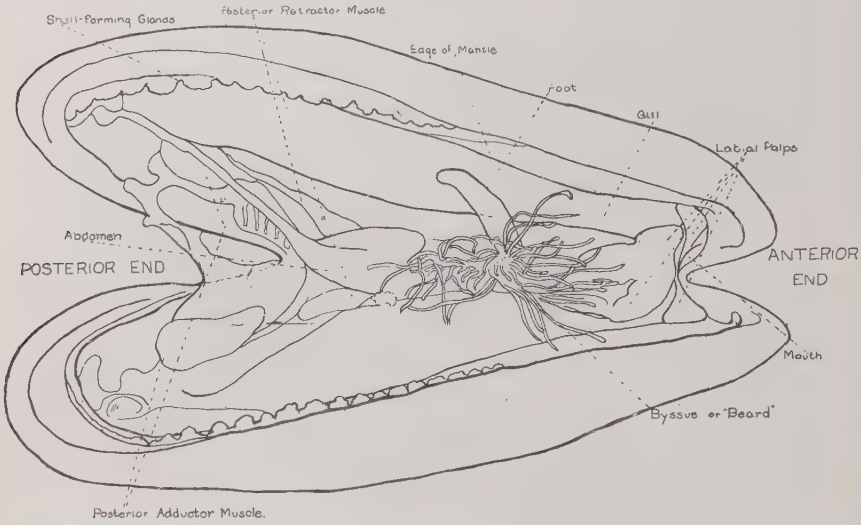

Fig. 62. Diagram showing the interior structure of a California mussel.

Members of the species *californianus* mature in about two seasons, and in that time attain a length of from two to four inches. At the Scripps Biological Station, near La Jolla, a concrete pier was put down in November, 1915; in July, 1917, two seasons later, most of the piles were thickly clustered with mussels, some of which were four inches long. It is not known what the life of the mussel is, but it probably is six or seven years at least, and possibly longer.

As is the case with other mollusks closely related to it, for instance, the clam and the oyster, the mussel swallows everything that comes his way. He simply opens his mouth, lets the sea water enter, and then proceeds to digest and to assimilate whatever there may be of value as food. The water teems with organisms that are microscopic in size; among them are the diatoms, which are one-celled plants, and many species of protozoans or one-celled animals. These constitute the bulk of the food of mollusks like the mussel. It has been demonstrated that diatoms constitute 98 per cent of the bulk of the food of the oyster, and the mussel likely uses about the same quantity of diatoms in its diet. To be sure,

undesirable substances, as well as desirable ones, find their way into the mussel's digestive tract, for the mussel has no power of selection and everything that is small enough is taken in with each swallow of water. For this reason, there is danger in eating mussels which have lived in polluted or stagnant waters, because disease germs and poisonous substances may be harbored in the animal's body. But there is no danger from this source when the mussels are taken from the clean sea water of the open shore.

Sporadic cases of poisoning have occurred on the Pacific coast and elsewhere. Though many have been attributed to ptomaine, their cause is not definitely known. The evidence goes to show that, in most of these cases, the mussels had been gathered from high up on the rocks, either during or immediately following a period of hot weather. Because of this, during the summer months one should not eat mussels unless they have been taken *from under the water.*

For a long while fresh mussels have been on the market in a few of the restaurants, though in limited quantities. It is only within the last few years that any attempt has been made to can them on the Pacific coast. Their preparation for the market involves no little labor and considerable handling. It was our privilege, a short time ago, to watch the process of getting mussels ready for the San Francisco market. These mussels were of the small species, *M. edulis,* taken in the bay.

Put into deep, wire-bottomed trays, they were washed thoroughly to remove the mud and silt adhering to the shells. Then they were transferred to narrow wooden vats, where they were "worked," much as mortar is worked, by two men with hoe-like rakes; this process serves to separate the mussels one from another and to remove many of the barnacles from the shells. From here the mussels were hauled to a shed in which was a long table, on which they were dumped; then, taking one mussel at a time, the men went through the whole pile, throwing out broken shells and dead mussels, and with flat iron bars knocking off the remaining barnacles. The fresh mussels, washed and cleaned, were then ready for market.

For canning purposes, the perliminary process is practically the same as that just outlined. Having been cleaned, the mussels are placed in trays in an oven or a retort, and heated till they open. The meats and the liquor are placed in cans which, after being sealed, are put into the retort again and subjected to steam heat for a certain sufficient length of time to cook the mussels and to sterilize the contents of the cans. They are then ready for the market.

Both fresh and canned mussels can be prepared for table use as readily and as quickly as can oysters. They are wholesome, nutritious and deliciously flavored; moreover, they are as cheap a food as can be had in these days of increasing expenses. Several packers in California are making preparations to begin the packing of this food, hitherto unutilized, and it is hoped that before another year has gone by the mussel will be a staple and "standard" article of diet.

3—38800

THE MACKEREL AND MACKEREL-LIKE FISHES OF CALIFORNIA.*

By EDWIN CHAPIN STARKS, Stanford University.

The group composing the mackerel and mackerel-like fishes is commercially one of the world's most important groups of fishes containing as it does the true mackerel of the Atlantic coast and the albacore of the California coast. Only the herring group surpasses it in value. It contains some of the swiftest fishes that swim as well as some of the largest. Most members of the group are built for speed, the fins folding into grooves in the body, the mouth and gill covers fitting tightly and smoothly, and with no projections on the head or body to break the continuous curves. The contours are said by nautical engineers to be perfect for passage through the water with the least resistance. But among these fishes are many variations of form of body, some of which are not at all adapted to swift swimming.

Usually the head is sharp, the tail slender and with a widely forked caudal fin, the scales very small and thin, and the color silvery and metallic. Usually the dorsal and anal are elevated to a point in front with the outline just behind the point concave. Many of them have the pectoral fins scythe-shaped, and most of them have a keel on each side of the tail.

These fishes are closely related to the bass-like fishes. Though differing from them very much in the extremes they grade into them, on the other hand, so that they can be separated only arbitrarily.

Among the mackerel-like fishes are several pelagic fishes or fishes of the high seas, that are occasionally taken on our shores, but so rarely that there is little reason for including them in a report of this character.

GLOSSARY.

Air bladder: A thin walled sac lying in the upper part of the abdominal cavity.

Anal fin: The fin on the lower side of the body. Sometimes in two parts but never paired (two side by side).

Caudal fin: The tail fin.

Compressed: Said of the body when it is flattened from side to side.

Dorsal fin: The fin on the back, often divided into two fins, the first usually of stiff spines and hence called spinous dorsal.

Finlets: The little detached fins behind the dorsal and anal in the mackerels.

Keel: The sharp projecting ridge at the side of the tail.

Maxillary: The flattened bone bordering the mouth above.

Pectoral fin: The uppermost of the paired fins. Situated close to the gill opening.

Ventral fins: The paired fins on the lower part of the breast, close under the pectorals in these fishes.

*A report of the Committee on Zoological Investigations of the State Council of Defense.

Families of the Mackerel and Mackerel-Like Fishes.

Small finlets follow the dorsal and anal fins. A projecting keel on each side of tail (except in *Scomber*). Ventral fins present. *The Mackerels* (*Family Scombridæ*) page 119.

No finlets follow the dorsal and anal fins. A projecting keel or ridge on each side of tail. Ventral fins present. *The Yellow-Tail and Horse-Mackerel* (*Family Carangidæ*) page 124.

Upper jaw prolonged into a sword. A pair of long single rayed ventral fins present. *The Marlin-Spike Fishes* (*Family Istiophoridæ*) page 126.

Upper jaw prolonged into a sword. No ventral fins present. *The Swordfishes* (*Family Xiphiidæ*) page 127.

A single long dorsal and anal fin without sharp spines. Body deep and compressed. No ventral fins. *The California Pampano* (*Family Stromateidæ*) page 128.

THE MACKERELS.

(*Family Scombridæ.*)

In this family are the mackerel, bonito, skipjack, albacore, and Spanish mackerel. All but the mackerel (*Scomber*) have a keel-like projection on the side of the tail with sometimes a pair of small ones. *Scomber* lacks the keel in the middle of the side but has a pair of small ones on each side. Most of the mackerels have very small scales. In some of them these are enlarged and crowded together at the front of the body in a corslet. In all of them the dorsal and anal fins are followed by detached finlets. The caudal is widely forked and the tail exceedingly slender. The color is usually metallic steel-blue and bright silvery.

The Mackerel (Scomber japonicus).

The mackerel has a high, triangular first dorsal fin with 9 or 10 spines. It is separated by a considerable space from the second dorsal, which is much lower. The anal is similar to the second dorsal and is a trifle behind it. Both dorsal and anal fins are followed by 5 or 6 finlets.

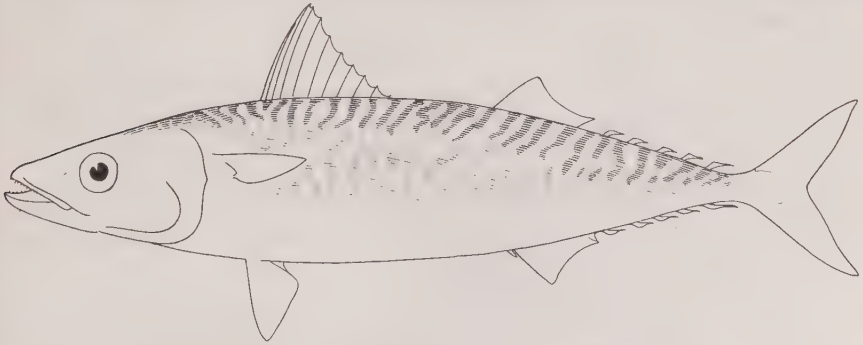

Fig. 63. The mackerel (*Scomber japonicus*).

The pectoral fin is rather short, or about as long as the distance from the eye to the gill opening. On each side of the tail are a pair of keel-like projections. The color most readily distinguishes the mackerel from its relatives. It is blue above and silvery below, with many crooked, blackish bars extending downward from the back to the middle

of the side. The lower part of the side is usually more or less mottled with dusky blotches.

In California, though we call this fish the mackerel, without differentiating it from the true mackerel of the Atlantic, we must remember that it is a very different fish. It differs particularly in having an air bladder which is entirely lacking in the true mackerel. Its dark bars are not so clearly cut, and it has a larger eye. The true mackerel has no dusky mottled spots on the lower part of the side, and there are several other differences.

This mackerel is widely distributed over the Atlantic and Pacific oceans, being found north to England, Maine and San Francisco. It is common in the Mediterranean and in southern California. It may be that more than one species is found in this wide range, but no one has as yet found any characters that are constant enough to separate it. It is known as the chub, or thimble eyed, or tinker mackerel on the East coast. It is somewhat inferior to the true mackerel, but nevertheless it is a good and important food fish, particularly good broiled or baked, and attention is now being directed towards canning it, or salting it in wooden kits as the Eastern mackerel is. Recent Atlantic coast quotations (early May) list this fish under the name of tinker mackerel at from 28 cents to 35 cents a pound in the wholesale market. It retails in California at 10 cents a pound.

(The Spanish Mackerel (Scomberomorus sierra).

The Spanish mackerel may be known by the long slender body, the teeth flattened and dagger-shaped, the spinous dorsal long and with little space between it and the second dorsal, and particularly by the spots on the side of the body. The maxillary reaches to below the hind

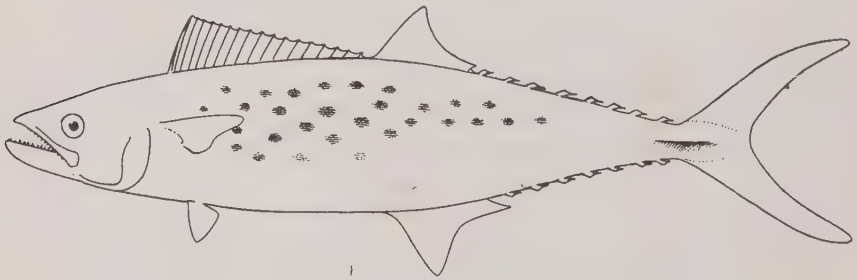

Fig. 64. The Spanish mackerel (*Scomberomorus sierra*).

border of the eye. The length of the head is equal to, or exceeds but little, the greatest depth of the body. It has 9 finlets behind the dorsal and the anal. The color is silvery on the side and lower parts and dark blue on the back. On the side are five or six rows of elliptical spots of bluish or dull orange color.

This fish is common on the Pacific coast of Mexico and has been reported in some abundance off San Diego. It is hoped that when it is next seen within our waters its occurrence may be reported to the Fish and Game Commission in San Francisco and if possible a specimen saved.

On the Atlantic coast is a Spanish mackerel that is very close to ours, if not identical with it, that is valued among the very best of food fishes. The name Spanish mackerel has been applied to various mackerel-like fishes, but this and the next are the only ones on our coast that should be so called. In England our common mackerel is called Spanish mackerel, and in California the oceanic bonito is also sometimes given that name.

The Monterey Spanish Mackerel (Scomberomorus concolor).

This fish resembles the last (*S. sierra*) in general characters, but it may be most easily distinguished from it by the sides having only two series of spots (female) or none at all (male).

It appeared in Monterey Bay nearly 40 years ago and for a few years was taken in some abundance, appearing each year in September and staying only a couple of months. It commanded a high price in the market. Since that time it has never been reported, nor is it known from any other locality. If ever taken specimens should be preserved in formalin (1 part formalin, 15 parts water) and sent to the Fish and Game Commission.

The Skipjack (Sarda chilensis).

This species is rather slender, though less so than the Spanish mackerel. It may be known by the narrow dark stripes on the back that do not follow the outline of the back but run obliquely back and slightly up from the side. The lower ones run from the region of the

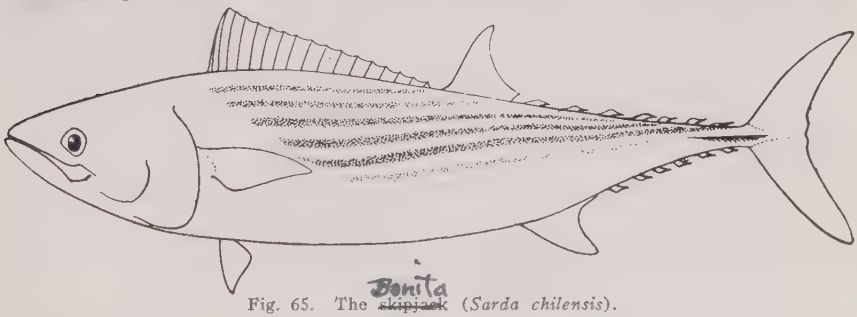

Fig. 65. The skipjack (*Sarda chilensis*).

pectoral to the upper part of the tail and the last dorsal finlets. The front of the anal is behind the second dorsal. The pectoral is short and its length is about equal to the distance from the eye to the gill opening. The length of the head is greater than the depth of the body. It has seven or eight finlets behind the dorsal, and six or seven behind the anal.

The skipjack is found in abundance in summer on the California coast and is known as far northward as Puget Sound. It is common along the South American coast and in Japan. It reaches a length of three feet and its flesh is dark red, oily, and rather coarse.

The Tuna, or Tunny (Thunnus thynnus).

The tuna, or leaping tuna of the anglers, may usually be known by its great size, but size can not be altogether relied upon to distinguish it. It is a deep, thick, heavy-bodied fish, with a pectoral fin shorter

than the length of the head and without conspicuous stripes on the body. The color is deep blue on the back but with greenish reflections,

Fig. 66. The tuna (*Thunnus thynnus*).

and the lower parts are silvery. When freshly caught it is very brilliant with a play of metallic colors. It is sometimes canned with the albacore under the same label, and is said to be equally good. Or perhaps it is better to say that it is canned under its own label, for the albacore is, unfortunately, canned under the label of tuna.

This fish is found in all warm seas, occurring as far north on our coast as San Francisco. It is known as the tunny on the Atlantic coast. The name we apply to it, tuna, is the name that is current in the Mediterranean. In the Atlantic it is reported to reach a weight of 1,500 pounds, and individuals weighing a thousand pounds are not very rare. None is recorded on the California coast nearly that large. The largest taken with hook and line weighed only 251 pounds. The tuna is probably the hardest fighting marine fish that is classed as a game fish. Devoted to its capture under certain regulations as to light tackle is the Tuna Club of Santa Catalina Island.

The Yellow-Finned Albacore (Thunnus macropterus).

This species, like the albacore and tuna, is a heavy-bodied fish. It may be known by its pectoral, which is shorter than in the albacore and longer than in the tuna. The pectoral reaches nearly or quite to

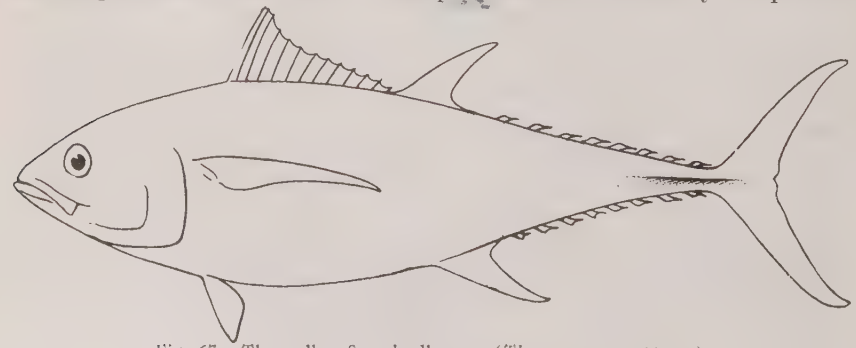

Fig. 67. The yellow-finned albacore (*Thunnus macropterus*).

the front of the anal fin, but not past it as in the albacore. The fin is longer than the length of the head. There are no conspicuous stripes on the body. The soft dorsal and anal fins are higher than those of the albacore, and the finlets are lemon-yellow.

This fish is common in Japan, somewhat less so than in the Hawaiian Islands, and at times is reported to be not rare about the Santa Barbara Islands. It is not common enough to be of commercial importance, though a game fish of note.

The Albacore (Thunnus alalunga).

The albacore may be known at once from all of the other mackerels by the great length of the pectoral fins, which reach considerably past the front of the anal, and are about two-fifths of the entire length of the fish. It is dark steel blue on the back shading to silvery below.

It is found in all warm seas and at certain seasons is common on the California coast, in Japan, and in the Mediterranean. On our Atlantic coast it is rare. On the California coast it occurs as far northward as San Francisco, though it has not been taken in abundance north of the Santa Barbara Channel. It is a fish of the high seas, and is not found

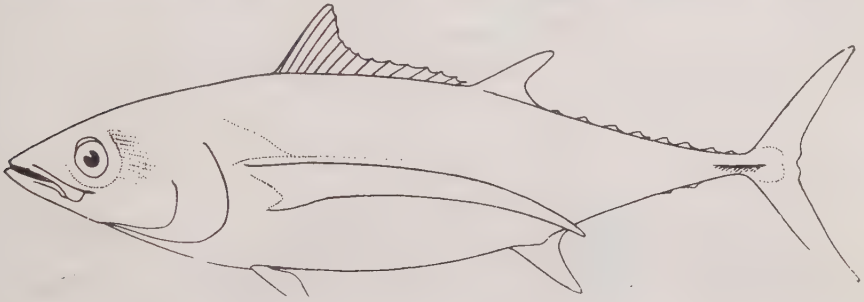

Fig. 68. The albacore (*Thunnus alalunga*).

in sheltered bays and rarely near shore. Its food is anchovies, sardines, squid, and small free-swimming fishes generally. It is most abundant from May to December, though it is taken in small numbers in other months. Nothing is known of its spawning habits or spawning grounds as yet on our Western coast. Individuals have been taken up to 70 or 80 pounds in weight, though the average is about 20 pounds. Very small ones are rarely seen on the California coast, though it has been taken as small as two or three pounds in weight. Once an entire school of small ones was reported.

As a food fish it has been little appreciated in America until within a very few years, when, canned under the name of tuna, it quickly became the most important fish in our state. This position it held until last year, when the sardine took the place of first importance. In Japan it is eaten raw.

Though the albacore is taken in abundance the demand is greater than the catch. Perhaps when some method of netting it is invented the catch may be greater. Now it is taken only by hook and line. In the commercial fisheries it is attracted to the boats by a process known as chumming.* It is trolled for by power boats, and when a "strike" is made quantities of live anchovies, sardines or other fishes are thrown overboard with the hope of attracting the school of albacore to the boat. If the school appears fishing begins with strong, short poles, short lines

*The term chumming is used on the Atlantic coast when ground bait or pieces of salt fish are used to attract a school of fish about the boat. Here it seems to be restricted to the use of live bait.

and barbless hooks baited with small fish. There is little sport in this sort of fishing and much hard work, for the albacore, if biting at all bite at once, and are lifted straight out of the water by main strength, shaken from the hook onto the deck and the hook at once baited again. Thus each fisherman may land a fish every minute or so. It is related that three men once averaged a ton each in a half hour. But the albacore is very erratic in taking the hook, or in appearing at all, or when biting well may suddenly stop, so that the catch is uncertain.

In an old book on English fisheries (W. Yarrell) I note that on the coast of France this fish is caught abundantly at a depth of 80 fathoms; that it rises to the surface to pursue flying fishes, but that fishermen take few except at great depths. This is interesting in light of the fact that ours are practically all taken at the surface. Experimental fishing may show that ours may also be taken at a depth, perhaps at times when they can not be taken otherwise.

The Oceanic Bonito (Euthynnus pelamis).

This species may be recognized by four or five dark stripes on the lower part of the side that are parallel with the lower outline of the

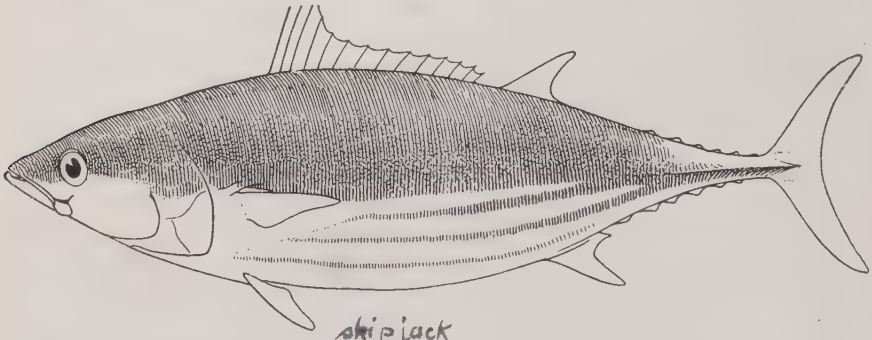

Fig. 69. The ~~oceanic~~ bonito (*Enthynnus pelamis*).

body. The back is bluish and the belly silvery, while the stripes are brownish or coppery color. The general shape of the body is similar to that of the albacore and tuna.

This fish is sometimes called skipjack by anglers, but *Sarda chilensis* has a better right to that name. Probably this confusion has arisen because both of these fishes have stripes, but the stripes on the skipjack are on the back and are not parallel with the outline of the body, while on this fish they are on the lower part of the body and are parallel with the outline.

The oceanic bonito is found in the warmer parts of the Atlantic and Pacific oceans. It is reported to be frequently taken about the Santa Barbara Islands.

THE YELLOWTAIL AND HORSE MACKEREL.

(*Family Carangidæ.*)

This is a large family especially well represented in tropical waters. Two only are found commonly within our limits. Among them are the pampanos (not the California pampano, which is a butter-fish) the cravelles, the pilot fishes, the horse mackerels, the yellowtails, and many

others. The tail is slender and the caudal fin forked. In both of our species there is a keel (though slight in the yellowtail) on the side of the tail, and no dorsal or anal finlets are present.

The Yellowtail (Seriola dorsalis).*

This fish is overed with small scales, some of them being on the cheek just behind and below the eye. The pectoral fin is rather short, about half as long as the head, and does not reach past the ventral fins. It has a slight ridge-like keel on the side of the tail, but this is much less developed than in the bonito or albacore. The first or spinous dorsal is considerably lower than the second. The front of the anal fin is a considerable distance behind the front of the dorsal and behind the middle of the body. The color is bright steel blue above and dull silvery on the side and lower parts. A yellowish irregular band extends along the side. The caudal fin is a dull yellow.

This fish is found from the southern California coast southward along the coast of Mexico. The largest one recorded weighed 60½ pounds, and

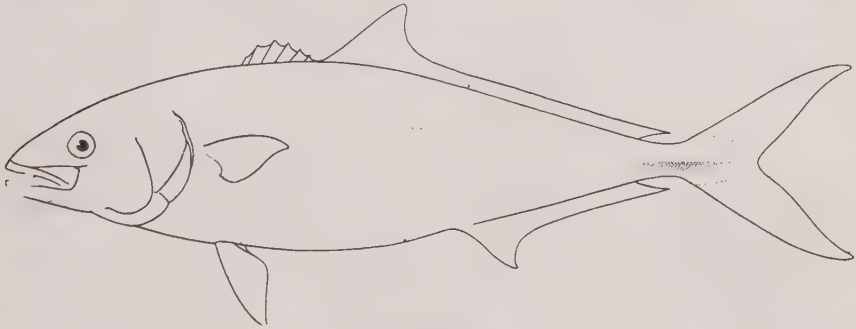

Fig. 70. The yellowtail (*Seriola dorsalis*).

this was taken with light tackle (Tuna Club record). The yellowtail is an excellent food fish and abundant enough to be of considerable importance. It is now being canned to some extent. As a game fish it has long been famous and it holds an important place in the affections of the angler.

The Horse Mackerel (Trachurus symmetricus).

The horse mackerel may be known by its having a row of vertical bony plates along the side. Above the pectoral fin this row is rather high on the side, but under the front of the second dorsal it bends down and runs straight along the middle of the side to the tail where it forms a sharp bony keel. Southward along the Mexican coast are other species with this row of bony plates, but this is the only one found within our limits.† The lower jaw projects slightly past the upper one, and the maxillary extends to under the front of the pupil. The first

*Related to the yellowtail is the pilot fish (*Naucrates ductor*). It is not given a place here because it has been taken only once or twice on our coast. It has a much lower spinous dorsal, wider keel on the tail, and smaller mouth than the yellowtail has. About five broad dark bars extend from the back to the lower part of the body.

†In 1858 another species (*Caranx caballus*) having these bony plates was taken at San Diego, but as it has not since been seen so far north it is not included here. It is common in the tropics and may be found again, so any fish besides the horse mackerel with bony plates forming a keel on the tail should be preserved.

dorsal is high and triangular, and has about eight spines. The front of the second dorsal and anal are high and pointed. The anal is preceded by two strong spines and is behind the front of the second dorsal.

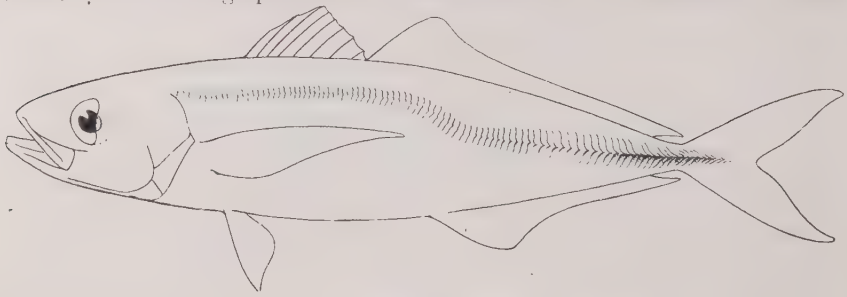

Fig. 71. The horse mackerel (*Trachurus symmetricus*).

The pectoral fin reaches to or a little past the anal spines. The back is greenish shading downward to silvery on the lower parts.

The horse mackerel is found abundantly from San Francisco southward. As a food fish it is inferior to the mackerel, being rather coarse fleshed. Little has been done in preserving it.

THE MARLIN-SPIKE FISHES.

(*Family Istiophoridæ.*)

In this family are the sailfishes (*Istiophorus*), and spearfishes of the Atlantic, and the marlin-spike fishes of the Pacific. The spearfishes and marlin-spike fishes belong to the same genus (*Tetrapterus*) though of different species. The fishes of this family differ from the true swordfishes in having small granular teeth in the mouth, in having ventral fins, and in having two keel-like projections on each side of the tail.

The Marlin-Spike Fish (Tetrapterus mitsukurii).

This species may be known by its upper jaw being prolonged into a "sword" together with its having long ventral fins composed of one ray each. The first dorsal fin is high in front where it rises to a point,

Fig. 72. The marlin-spike fish (*Tetrapterus mitsukurii*).

and is as high or a little higher than the depth of the body. The dorsal quickly becomes lower and runs for nearly the whole length of the back as a low fin, gradually growing lower and disappearing. The second dorsal is small and short; the front of it elevated to a point. The pectoral fin is about as long as the dorsal is high. The anal fin is divided

into two parts, both parts with the front elevated as in the dorsals. The first anal is about three times as high as the second, which is a little in front of the second dorsal. The sword is not sharp edged but rounded, and the point of the lower jaw reaches nearly half of the distance from the eye to the tip of the sword. The body is crossed by narrow light stripes extending down from the back.

The marlin-spike fish reaches a length of 12 feet or more. The largest one recorded by the Tuna Club taken under their specifications of light tackle weighed 340 pounds. It is now known only from Japan and the California coast, though this range will doubtless be extended when other localities are known.

Much controversy is carried on among anglers as to whether this fish may or may not be called a swordfish. It would appear that the catching of anything that bears the name of swordfish carries with it more glory than the catching of a marlin-spike fish, though I believe it is conceded that the latter is the greater fighter. If that be true why not let it stand on its own merits? The name marlin-spike sword fish being too long and somewhat ambiguous in that the sword is twice referred to, the angler has left off a very descriptive part of it and calls it the marlin swordfish, though marlin without the spike obviously means nothing at all in this connection. As this fish belongs to the same genus as the Atlantic spearfish it would be consistent to call it the Pacific spearfish. However there are, unfortunately, no rules or laws governing the use of common names so there is no reason why this fish should not be called a swordfish if it is sufficiently distinguished from the fish that has the best right to the name.

On acount of anatomical differences the swordfish is placed in one family and the marlin-spike fishes, the spearfishes, and the sailfishes in another, thus indicating that the last three are more closely related to each other than they are to the swordfishes. The angler apparently objects to placing this fish in a family separate from the swordfish chiefly because it seems to rob him of his right to call it a swordfish. But considering groups higher than families they are all grouped together in a superfamily—marlin-spike, sail, and swordfishes—and spoken of as "the swordfishes." That is a zoological license for considering the marlin-spike fish a swordfish.

On the southern California coast there is a little fish that has the lower jaw prolonged into a sword. It does not exceed a length of seven or eight inches, and is often called the little swordfish. And that is an equivocal license for calling the marlin-spike fish a swordfish, for the little swordfish is not at all related to the big one.

THE SWORDFISHES.

(*Family Xiphiidæ.*)

In this family is the swordfish, cosmopolitan in its distribution. Only one species is now recognized. But these large fishes have not been very carefully studied owing to the lack of carefully made and accurate descriptions, and to the impossibility of preserving fishes of such size. It is not improbable that future study will reveal more than one species. Teeth are present only in the young. The ventral fins

are entirely wanting, and even the internal bones (pelvic girdle) for their support. On each side of the tail is a wide projecting keel.

The Swordfish (Xiphias gladius).

Called broadbill swordfish by anglers. The upper jaw is prolonged into a much longer sword than in the marlin-spike fish. The lower jaw does not reach over a quarter or a fifth of the distance from the eye to the tip of the sword. The sword is flattened and sharp edged. The first dorsal fin is high, curved and short, being much higher than it is long. The second is very small and is back on the tail; its height is less than the diameter of the eye. The anal is also divided into two parts. The first anal resembles the first dorsal in shape, but is much

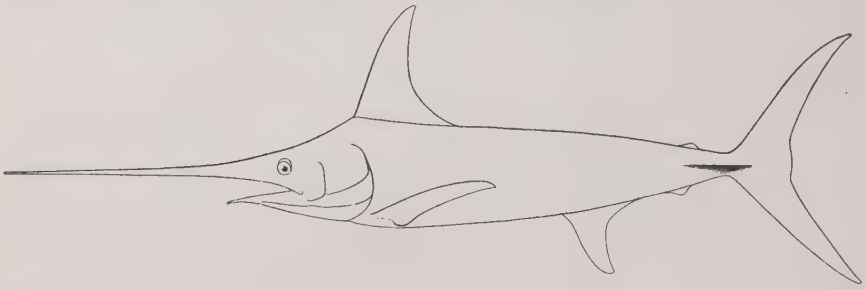

Fig. 73. The swordfish (*Xiphias gladius*).

smaller and situated behind the middle of the body. The second anal is a little in front of the second dorsal. The pectoral fins are about as long as the height of the first dorsal. The body is metallic purplish in color above and dusky below. It has no cross bars of color.

In the young the dorsal and anal are each continuous as a single long fin, but as the fish grows older the central part of the fin disappears leaving only the two ends.

The swordfish is the object of extensive fisheries on the Atlantic coast, where from 3,000 to 6,000 are taken every year. On our coast it is regarded more as a game fish than as a commercial fish, though the few that are caught find a good market. It reaches a weight of over 600 pounds. In the Tuna Club handbook for 1917 the largest recorded taken with light tackle weighed 362 pounds, but I believe that record has since been very much beaten.

The swordfish is the swashbuckler of the sea, attacking with ready sword everything that floats. It must not be confused with the sawfish, which belongs to the group of sharks and skates.

THE BUTTER FISHES.

(*Family Stromateidæ.*)

Belonging to this family are the butter fishes, or harvest fishes of our Atlantic coast, and the so-called pampano of California. They are only distantly related to the mackerel group, but more nearly related than to any other group that will be treated of in these papers, and so are here included. The family is represented in California by one species. It has no separate first, or spinous, dorsal, and no ventral fins. The body is deep and thin (compressed).

The California Pampano (Palometa simillimus).

The body is compressed and deep; about half as deep as it is long without the caudal. It is covered with fine scales. The profile of the head is rounded and with a blunt curved snout. The single dorsal and anal are similar, long, highest in front, low behind, and extending

Fig. 74. The California Pampano (*Palometa simillimus*).

nearly to the caudal fin. The front of the anal is behind that of the dorsal. The pectoral is long. When turned forward it reaches past the snout, and in its natural position far beyond the front of the anal, or nearly half way from its base to the caudal fin. It is bluish above and silvery below.

This is a highly prized food fish, reaching a length of 10 inches, and found from Puget Sound to San Diego. About central California it is abundant in summer. Its flesh is rich and delicate. It is not related to the famous pampano of Florida, there being nothing between them in common more than the shape of the body, but it is one of the butter fishes of the East coast.

DISCRETIONARY POWERS AND GAME CONSERVATION.

By HAROLD C. BRYANT.

California for many years has administered fish and game affairs in an unscientific way. The power to make or change fish and game laws is vested only in the state legislature. The laws are enacted for at least two years and no change can be made in them during that time, irrespective of the fact that new conditions may arise and serious injuries result. Frequently it is impossible to secure the attention of lawmakers to matters that are of the greatest importance and it is impossible to put legislation into effect that is really necessary. In general, however, it may be said that our laws are as satisfactory as they can be under the present system.

WHY DISCRETIONARY POWERS ARE NEEDED.

A few years ago during the eruption of Mount Lassen, a mud flow destroyed all of the fish in Hat Creek. This creek was one of the best

streams in California and literally teamed with trout. In order to bring this stream back, it should have been heavily stocked and all fishing prohibited for at least two years. If this had been done, fishing in Hat Creek would have been as good or even better than before. The commission was powerless to close this stream.

In Inyo County a few years ago during a severe winter a great many of the mountain quail in that county were killed. It was not possible for the commission to suspend the open season for mountain quail in the fall of the year although that should have been done. The birds have not yet approached their former numbers and will not until additional protection can be given.

In 1912 in Trinity and adjoining counties a very severe epidemic occurred among the deer. Thousands of the animals were found dead. The animals remaining were not in the best physical condition and were perhaps not fit for human consumption. Certainly they were needed for breeding stock to bring back the deer to their former numbers, but it was not possible to give them protection in time.

Every few years an epidemic has occurred among wild ducks in the lower San Joaquin Valley. Thousands of ducks have died. The disease is prevalent at the time the season opens. Hundreds of sick birds are killed by market hunters and shipped to the San Francisco and Los Angeles markets. Some way should be devised whereby the killing of these sick birds can be prevented.

The coast streams are sometimes in best shape for steelhead fishing at the first of April; other years the streams should not be fished until during the month of May. It is not possible to have a fixed law that will be satisfactory.

Almost every state is from time to time confronted with problems that develop during a period of drought. If several dry winters follow in close succession, the food supply of game birds such as quail is greatly diminished and the numbers of these birds are reduced to the minimum on account of the scarcity of food and unfavorable breeding seasons. The number of birds killed during such years by hunters should be cut down in order to conserve the breeding stock. It is impossible to do so under a system that is wholly controlled by the legislature. Forest fires often cause similar conditions which demand immediate action.

During the strenuous times through which we are now passing with the world at war, we are impressed with the necessity for making immediate changes in our laws so as to provide for the greatest production of fisheries products. The laws regulating the taking of fish can not be modified until the legislature meets. If the Fish and Game Commission had discretionary powers, the use of nets in prohibited waters and the use of other kinds of nets that should be probihited under normal conditions could be allowed and the fish markets of the state provided with a greater abundance of fish. After the war, the laws could be restored; perhaps made a little more severe in order to bring back the fish to their original numbers.

OTHER STATE COMMISSIONS HAVE DISCRETIONARY POWERS.

It has been found necessary in order to properly safeguard the horticultural and agricultural interests of the state against injurious insects to give discretionary powers to the State Horticultural Commission. It has also been deemed necessary to give such powers to the

State Board of Health. Discretionary powers have been given to these boards by the state legislature, so that it would not be without precedent were the Fish and Game Commission given similar powers.

GAME COMMISSIONS IN OTHER STATES HAVE DISCRETIONARY POWERS.

California would not be taking an untried step if the Fish and Game Commission was allowed to use its discretion in times of necessity.

In Maine, newly-stocked streams are closed to fishing at the direction of the Fish and Game Commission.

The New York Conservation Commission has power to change the deer season according to the conditions that may arise in the different localities.

In Washington, the commission has the power to close any lake or stream for fishing, should in their opinion the fish in these streams or lakes require additional protection.

In Oregon, the commission has power to close or suspend the open season for the taking of game or fish at will.

In Nevada, the Board of County Commissioners can change the open season on many different species of game.

In Michigan the state game, fish and forest fire commissioner of the Public Domain Commission, has the power to suspend, abridge or otherwise regulate the open season on any kind of game or fur-bearing animals or game birds found in a wild state in any designated area, where it becomes necessary to assist in the increase or better protection of any particular kind or species of such game.

Similar authority is delegated to game commissions in other states.

Congress has placed in the hands of the Department of Agriculture discretionary powers in order that the Federal Migratory Bird Law may be properly enforced.

According to the Minister of Game and Fisheries of Canada, no provision in the game act of that country has proven so useful as has the section under which the Lieutenant Governor in Council may make legislation preventing the hunting of game that may appear to require more protection than is given by the act.

SOME SOLUTION NECESSARY.

The conditions above outlined, which are of more or less regular occurrence, demand attention. It is evident that present laws applied to these conditions do not allow a solution of the problems presented. Some provision must be made to better care for such situations. Other states have given discretionary powers to the Fish and Game Commission or to the Governor and we could improve conditions in the same way. Without such powers the Fish and Game Commission can not do efficient work.

HISTORY OF LAW GIVING DISCRETIONARY POWERS.

As early as 1895, the importance of allowing the Fish and Game Commission the right to make certain regulations during the interim between the meetings of the legislature was recognized. But the suggestion was opposed by those who felt that autocratic powers were being given the commission. Increasing difficulty in properly conserving wild life under the present system of laws led the Fish and Game Commission

to bring the question before the 1917 legislature. Those opposing the measure claimed that it would be unconstitutional. The need for greater leeway in giving local protection to fish and game becomes more apparent from year to year and further attempts are sure to follow until an act which will improve present conditions is obtained.

A MODEL LAW.

What sort of a law would meet the needs in California? Before answering this question let us look at some of the laws found workable in other states.

Pennsylvania's law reads as follows:

"* * * That from and after the passage of this act, the Governor of Pennsylvania shall have authority, through proclamation, to close for a period not exceeding one season at one time, any county or counties or any section of any county, of this commonwealth, to either hunting or fishing, or to close any stream or part of streams to fishing, because of excessive drought and consequent danger from forest fires, low water, and the presence of contagious or infectious diseases, when such action may be necessary to conserve either the health or welfare of our people or our natural resources."

This act provides a penalty of not less than twenty-five dollars or more than one hundred dollars. (Proclamation issued under Pennsylvania Act, P. L. 1915, 530, Sec. 1.)

Full power to suspend laws is given the State Game Warden of Arizona:

Sec. 14 (*a*). The State Game Warden shall have power to suspend the open season on any kind of game in any designated area where, in his judgment it becomes necessary for the protection of any particular kind or species of game threatened with extermination.

The New York law is more complicated:

"1. Petition for protection. Ten or more citizens of the state may file with the commission a petition in writing requesting it to give to any species of fish other than migratory food fish of the sea, including fish or game birds or quadrupeds, protection or additional protection to that afforded by the provisions of this article. Such petition shall state the grounds upon which such protection is considered necessary, and shall be signed by the petitioners who shall attach their addresses.

"2. Notice of hearings. If the commission shall after hearing petitioner entertain the petition, it shall hold a public hearing in the locality or county to be affected upon the allegations of such petition at such time and place within the locality or county affected as the commission may determine within twenty days from the filing thereof. At least ten days prior to such hearing notice thereof, stating the time and place at which such hearing shall be held, shall be advertised in a newspaper to be selected by the commission and published in the counties or county to be affected by such additional or other protection or if less than a whole county, in or near the locality which shall be affected. Such notice shall contain a brief statement of the grounds upon which such application is made, and a copy thereof shall be mailed to such petitioner at the address given in such petition at least ten days before such hearing.

"3. Powers to grant protection. If upon such hearing the commission shall determine that such species of fish or game, by reason of disease, danger of extermination or from any other cause or reason, requires such additional or other protection, in any locality or throughout the state, the commission shall have power by order to prohibit or regulate, during the open season thereof, the taking of such species of fish or game. Such prohibition or regulation may be made general throughout the state or confined to a particular part or district thereof and the order shall fix the day when the same shall take effect and the commission shall sign and enter the order in its minute book."

A public hearing and proper publicity is demanded in the Maine law:

"The commissioners of inland fisheries and game shall have general supervision of the enforcement of the inland fish and game laws. Whenever they shall deem it for the best interests of the state after due notice and public hearing in the locality to be affected, they may regulate the times and places in which and the circumstances under which game and inland fish may be taken for a series of years not exceeding four, but they can not authorize the taking of game or inland fish at a time in which its capture is prohibited by the laws of the state. They may, from time to time, modify or repeal such needful rules and regulations, not contrary

to the laws of the state, as they may deem necessary and proper for the protection and preservation of the game and inland fish of the state. They shall file, in the offices of the clerks of the towns in the territory to be affected a copy of the rules and regulations adopted by them and publish the same three weeks successively in a newspaper printed in the county, and post on the banks of waters to be affected, as nearly as may be like notices; and whenever any such rules or regulations apply to any organized township, a like copy shall be filed with the clerk of courts for that county, and published three weeks successively in a newspaper printed in the county; they shall, immediately upon the adoption of any rules and regulations contemplated by this section, file an attested copy of the same in the office of the Secretary of State. (Provides penalty, maximum one hundred dollars.) (P. L. 1915, Sec. 15.)

It will be seen from the following that the proposed California law attempts to make use of the best provisions found in the laws of other states. It does not deprive the legislature of its right to legislate on game but simply provides that temporary changes may be made in emergencies. The following provision can be best inserted in the law by the addition of a paragraph to Section 642 of the Political Code relating to the duties and powers of the Fish and Game Commission.

Whenever, after due notice and hearing, it shall appear to the board of fish and game commissioners that any species of mammal, bird or fish of the State of California is threatened with extermination by reason of disease, excessive hunting or fishing, or any other cause, or that it is necessary to assist in the increase or better protection of any particular species of mammal, bird or fish, or that it is desired to introduce into this state any new species of mammal, bird or fish, the board of fish and game commissioners shall have power to regulate by suspending, shortening or lengthening the open season and by modifying restrictions on the mode of taking or the amount taken of such species of mammal, bird or fish, in any designated area, or waters, or stream, or part thereof, of this state, for a period not exceeding two years at one time, or until such time as new legislation thereon enacted by the state legislature shall become effective. During the suspension of any open season by the board of fish and game commissioners, all provisions of law relating to the closed season for such mammals, birds or fish shall be in force, and every person who violates any such provision shall be subject to the penalties prescribed therefor. Any order issued under authority hereof shall become effective on approval of the Governor of California and shall contain a description of the area, waters, stream, or parts thereof, affected, the time when it becomes operative and the period during which it shall be effective, and a copy thereof shall be published in at least one newspaper of general circulation in each county within the district or any part of the district in which the regulation or order shall apply, at least once a week for two successive weeks, and a certified copy of such order shall be filed in the office of the county clerk of each of said counties.

CONCLUSION.

1. It is apparent that under the present system the hands of the Fish and Game Commission are tied and that this body is powerless to give fish and game added protection in time of emergency.

2. The present situation can be improved by the passage of legislation giving the Fish and Game Commission discretionary powers.

3. With power to suit protection to each locality when unusual conditions arise, greatly improved results may be expected.

4. The feasibility of a law giving discretionary powers is evidenced by the successful operation of similar laws in other states.

5. Three important things can be accomplished by giving the Fish and Game Commission discretionary powers:

a. Legislation can be suited to the requirements of localities rather than whole districts.

b. Increased protection can be immediately afforded fish and game whenever unusual circumstances warrant it.

c. Increasing complication of the districting law can be remedied.

6. A law allowing discretionary powers in the administration of fish and game is the game law most needed at the present time.

CALIFORNIA'S "BIT."

By JOHN N. COBB.

While the commercial fishermen of all the states in the Union have been doing their "bit" in trying to replace the much needed meat and other food products sent to our allies on and near the fighting line, those of California have especially covered themselves with glory in this regard as the following comparison of fishery products produced in 1917 with certain other years plainly shows.

The United States census of 1908 showed a production by the commercial fishermen of California of 47,477,000 pounds, valued at $1,970,000. A later investigation of the United States Bureau of Fisheries showed that in 1915 our commercial fisheries produced 92,513,457 pounds, valued at $2,488,098, while reports made by the commercial fishermen to the California Fish and Game Commission for the twelve months ending September 30, 1917, and other sources, show that 1,000,020,428 pounds, valued at $7,697,598, were produced. This latter comprised 178,450,472 pounds of edible fish, valued at $5,353,514; 23,757,782 pounds of other edible fishery products (such as mollusks, crustaceans, etc.), valued at $2,138,190, and 797,812,174 pound of non-edible products (mostly kelp), valued at $205,894.

Arranged in tabular form the three years in question show as follows:

Year	Pounds	Value
1908	47,477,000	$1,970,000 00
1915	92,513,457	2,488,098 00
1917	1,000,020,428	7,697,598 00

The data given above represents the products as landed by the fishermen, and the value is that realized by them. A large number of canneries and other plants receive a considerable part of the products so landed and prepare them in various ways for shipment and sale throughout the world, the value of the products increasing many fold in these operations. The enormous amount of kelp gathered in California waters and utilized at the immense plants established in the southern part of the state since the outbreak of the war, is valued at only about $200,000, although when the potash and other chemicals are extracted their value runs into millions of dollars.

As a result of the efforts of our fishermen, California now occupies first place, so far as quantity produced is concerned, amongst the various states of the Union, Virginia, with 494,959,362 pounds, being a very poor second, and is surpassed in value of its fisheries by Alaska, Massachusetts, and Maine alone, in the order named, with values of $8,413,713, $7,992,756 and $7,742,647, respectively.

The total fishery production of the United States amounts to about 3,950,000,000 pounds, valued at approximately $84,500,000, and of this enormous production, the greate t by any nation, California produces about one-fourth of the quantity and about one-eleventh of the value.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

July 15, 1918.

"To the profiteering proposal of the Pseudo-Patriots, the Patriots for revenue only, that protection of wild life in war time be relaxed, the united hosts of conservation reply:

'YOU SHALL NOT PASS.'

"Let this be the slogan of every farmer, of all who dwell in the open, and of all who love nature and who wish to see our natural resources preserved for the perpetual use of our people and not destroyed for all time to gratify the greed of a moment."—Theodore Roosevelt.

KELP.

We have long realized the value of our fishery resources, but we have just begun to find out that there are other products of the sea which can be utilized. That the vegetable life, as well as the animal life, can be made a source of profit is shown by the kelp industry. Formerly used only for the making of souvenirs, the common kelp of the southern California coast is now the basis for the manufacture of potash, a material important in the manufacture of fertilizers and just now a necessary component of war ammunition. In recognition of a new and important industry, and in order to acquaint our readers with interesting facts related to the industry, we are issuing this "Kelp Number."

WHO'S TO BLAME?

To hear some persons talk one would think that the Fish and Game Commissioners were among those most to be detested. Some persons apparently even have a personal grievance against the men themselves. The truth of the matter is that such persons talk disparagingly of the Fish and Game Commission simply because the commission enforces the fish and game laws. It will be seen also that the professional agitators are almost always those who are commercially interested in fish and game.

Some statements made lead one to conclude that the Fish and Game Commission makes the game laws and that it alone must be held responsible for any disturbing provisions. Of course, this is not true. The legislature is entirely responsible for fish and game laws. One function of the Commission is to enforce these laws, and consequently it must stand along with other bodies which enforce the laws and be the subject of continual criticism. No matter how faithful a Fish and Game Commission may perform its duties it must still be the recipient of vituperations without number.

It is remarkable how many people believe that a law can be repealed or amended by attacking the Fish and Game Commission. Exactly the opposite attitude will bring the best results, because there is no better way to secure the repeal of a bad law than to rigidly enforce it. The state constitution provides for the initiative and recall, and relief is always possible by utilizing the lawful means at hand.

TALK VS. ACTION.

Statements to the effect that the game laws are not being enforced are far too common. Letters are constantly written to newspapers and statements made in public regarding known violations of the game laws. If the persons making these statements would be half as active in reporting violations to the proper authorities as they are in giving publicity to violations, conditions would be greatly improved. For some unknown reason people take delight in pointing out violations, but when asked to swear out a warrant for the arrest of a violator they immediately say, "Let George do it." A game warden can not always be on the spot when a game law is violated, but he can reach the spot and make a conviction if the proper information is furnished

him. When unselfish persons take an active interest in the enforcement of game laws we will hear fewer statements regarding alleged violations, and game will receive proper protection.

SHAD BECOME SCARCE.

As predicted by the Fish and Game Commission, the shad catch has been far below normal, owing to excessive fishing of the past few years. Five years ago shad fishermen were able to catch 5000 pounds a day. They obtained but fifty cents for a 200-pound box. Three years ago fishermen obtained one-half cent for buck shad and two cents for roe. This past year the average catch made by a fisherman is about 400 pounds. He now obtains three cents a pound for buck and five cents for roe shad.

FISH ESCAPE FROM BOULDIN ISLAND.

The completion of a levee around Bouldin Island, on the Lower San Joaquin River, impounded great numbers of bass and shad, as the island has been under water for some time. Fearing that large numbers of valuable food fish would be destroyed because unable to reach the river, the Fish and Game Commission decided to allow fishermen to take the fish in nets. The island was opened to fishermen at 9 o'clock on May 21, and many fishermen from Pittsburg were on hand. After all of the work of laying the nets, one of the largest catches noted was composed of two shad and two carp. The fishermen were quickly convinced that all of the fish had escaped and left immediately for other fishing grounds. Thus ended the controversy as to the large numbers of food fish which would be destroyed when the levee was completed. It may be necessary at a later time to rescue some of the smaller fish which have been impounded, but it has been clearly demonstrated that the food fish have already escaped into the river.

A DANGEROUS STATEMENT.

The following is an extract from an editorial which appeared in a leading newspaper of San Francisco:

"This much is certain that there is a lot of nonsense talked on the subject of game preservation. In whose interest is it protected? Not in that of the great mass with little opportunity for indulging in the luxury of killing things and in no way benefited by game as a table decoration. Nor is it in the interests of those engaged as farmers or fruit growers. That birds included in the protected list are destructive of crops can not be denied, and as our established rural industries are of infinitely greater importance than the pastime of sportsmen or the sentimentalities of the nature-worshipers our game laws should be amended so as to permit the destruction of all destructive creatures."

We trust that our readers are not convinced of the truth of these statements. Let us analyze some of them. Many persons are impressed by statements calling attention to the fact that the poor man has little chance to secure wild game. The fact is that the poor man has a far better chance of obtaining and utilizing game for food than in obtaining his share of use in public roads, public parks and public buildings, all of which belong to the people and for which each citizen is annually taxed. The utilization of these latter assets are far more dependent on wealth than is game.

What if we applied the rule suggested in the last statement that all destructive creatures be destroyed? We would soon discover that we were "cutting off our noses to spite our faces," for if everything has its rightful place in the balance of nature then the more creatures that are destroyed the greater is the balance upset. Controlling wild creatures is a different thing from destroying them utterly. Then, too, it must be remembered that some of our bird and animal pests do not rightly belong in our fauna. The house rat, house mouse and English sparrow are deserving of extermination. Native animals and birds may need to be controlled so that our interests may be cared for, but they are deserving of perpetuation, not of extinction.

Every conservationist must help point out the fallacy of such arguments. Anyone who reads the game laws knows that the farmer is definitely given the chance to protect his crops.

WAR PROFITEERS.

New evidence of operations of selfish interests which profit in the present emergency at the expense of wild-life conservation comes in daily. One of special importance that has come to our notice is a petition sent Food Administrator Hoover by two United States senators, and signed by many Montana men, urging the killing of all elk in Yellowstone Park.

Fig. 75. Trout, 159 in number, weighing 28 pounds, confiscated by Deputy Gyger from two violators, on the south fork of San Jacinto Creek, April 14, 1918. The fish were taken with flies out of season.

IS THIS JUSTICE?

Achille Paladini and W. S. Stewart, agent of the Glacier Fish Company of Pittsburg, were arrested recently on the charge of shipping 5600 pounds of striped bass out of the state. The men were convicted and fined $50 each by Justice of the Peace Jackson of Concord, Contra Costa County. We wonder what effect so small a fine will have on such a chronic offender as Paladini. Mr. Paladini cleared at least $600 on the striped bass transaction. What difference would it make to him if he had to pay $50 from his profits in paying a fine?

STATE PLUMAGE LAW EFFECTIVE.

The new law prohibiting the sale of aigrettes, plumes and like feathers has effectively stopped the commercialization of the plumage of birds in California. The first case made under this law resulted in a fine of $15 for the sale of a bird of paradise. The defendant was A. Larson, Jr., wholesale millinery dealer of Los Angeles. The excuse that he had secured the feathers before the law took effect had no weight with the judge.

UNITED STATES FOOD ADMINISTRATION MEMORANDUM ON THE USE OF GAME AS FOOD.

The problem of providing for the country a maximum supply of game as food has been carefully considered by the Food Commission. It has reached the conclusion that this maximum supply can best be obtained by constantly increasing the breeding reserve of game under present and even more progressive laws directed toward that end.

Up to a short time ago no fact is more clear than that the game of the country has been decreasing, some species even approaching the point of extinction. That the energies of the whole country have been directed toward increasing the stock of game is demonstrated by the fact that many state legislatures have decreased the amount of the game to be killed by individuals and shortened the seasons in which game could be killed. Notwithstanding these efforts, the decrease in game became so serious that a universal demand throughout the country persuaded Congress to pass a law placing the jurisdiction of migratory game birds under federal supervision. Canada passed through the same experience, as is proved by a treaty negotiated with the United States practically incorporating the terms of the migratory bird law passed by Congress. The result of better state laws and the migratory bird law has been a positive increase of waterfowl and a wide extension southward of the breeding of waterfowl. It is perfectly clear that this increased breeding reserve gives more individual citizens the opportunity to kill for food more game, which opportunities must necessarily increase each year proportionately to the increase of the breeding reserve.

Any effort to weaken the present laws or in any way relax them in one locality would immediately lead to a demand for such relaxation of laws in all other localities, insuring a rapid breakdown of the whole legal structure of present game protection erected after efforts extending over numerous years. Once the perfected laws were relaxed to the point where game could be killed more freely, notwithstanding the fact that numerous gunners have gone to war, the game would be quickly destroyed by largely increased

numbers of local gunners using modern methods of transportation, such as automobiles, motorboats, trolley roads and improved firearms. The present game supply of the country should be considered in exatly the same way as that of domestic stock and fowls, the breeding reserve of which should be increased to insure increased supplies for food. This is even more necessary for much of the wild game, since once it is destroyed to a certain point it will decrease under natural conditions to extinction and can never, as in the case of domestic stock, be restored.

To advocate the relaxation of state game laws would secure neither uniformity in action or results since state legislatures can not be brought to exactly the same views, and most of the states will not have regular sessions for another year. Since an attempted relaxation of laws would tend toward a rapid destruction of game, no emergency has as yet arisen sufficiently acute to warrant the Food Administration advocating the destruction or impairment of game which forms a valuable national asset.

It may be added that no extensions of the hunting season or bag limit beyond those now specified in the state game laws could be legally made without action by the state legislatures, most of which will not meet until a year from the coming winter. Furthermore, an action which could be taken in this country which would contravene the Migratory Bird Treaty between the United States and Great Britain as concerns the conservation of wildfowl would be deeply resented by Canada, which through considerable effort has secured the acceptance of all the provinces of the treaty and of the enabling act and regulations whereby it is to be enforced.

U. S. Food Administration.

HOW TO HELP.

There are many persons sufficiently interested in wild life to seek some way of helping in the conservation movement. Believing that one of the most fundamental methods of bringing about conservation in the future is to begin with school children, we are led to make the suggestion that such people demand that wild-life conservation be taught in the schools of their respective towns or cities. A talk with the principal or with the teachers will oftentimes accomplish the right end. The ability to properly teach nature study and wild-life conservation should be demanded of every prospective teacher.

LIMITS THE RULE.

The opening day of the 1918 trout season demonstrated that fish are even plentiful in the coastal streams near San Francisco. One of the fish and game deputies, working near Pescadero, San Mateo County, checked over forty-two limits of trout, and many other fishermen had very near the limit. The fish were not very large, but of sufficient size to make them the best kind of food.

THE POLLUTION OF PUBLIC WATERS.

The pollution of the public waters of the state has become a serious menace to fish life, and the Fish and Game Commission has for a number of years been using the powers given it by the legislature to stop this wanton destruction of fish.

Large quantities of fish in San Francisco and San Pablo bays are often so charged with petroleum that they are unfit for food. The principal offenders are the refining companies on the shores of San Francisco and San Pablo bays. The companies have been warned from time to time regarding this evil and have promised to stop the pollution, but, with few exceptions, have failed utterly to keep their agreements. They have been arrested numerous times and with but one exception have escaped punishment upon the promise to the court that the evil would be remedied. The defense frequently advanced by the several offending companies has been that the industry is more important to the people than the fish. Both are economically important, but the importance of one is no excuse for the destruction of the other, for it has been shown conclusively that the evil complained of can be remedied without impairing the operation of the plant. This has been demonstrated in almost every instance, for, as soon as an arrest

is made, the pollution is stopped temporarily, and then is continued again with greater aggravation. Consequently, if it can be stopped temporarily, it can be stopped permanently.

Another defense frequently advanced is that the expense of disposing of the waste oil, other than in the public waters of this state, is too great. Certainly it can not be contended that the money expended by any oil company to prevent this pollution would represent, in the smallest degree, the value of the fish destroyed.

There are only a few of nature's gifts which have not been appropriated and exploited by corporate greed and which the public are privileged to enjoy. These are air, fish and game, and, regardless of expense, they should be perpetuated.

One of the best illustrations of the willful and malicious pollutions to which the attention of this commission has been called is that of two oil companies operating on Edna Creek in San Luis Obispo County. This stream is one of the largest and best trout streams in the county. For some time the companies on its banks have run their waste oil into the creek, polluting it for many miles, so charging fish with oil as to make them unfit for food, and making the water unfit to drink, either for man or beast. The companies have been warned numerous times to cease polluting the water of Edna Creek, which warning they have failed to heed, and as a result they were arrested recently and convicted and fined. Within twenty-four hours after they were convicted, the pollution ceased, and the sump holes, from which pipes and ditches lead into the creek, were filled in or disconnected.

This same condition prevails along the shores of San Francisco and San Pablo bays.

The pollution of the public waters can and must be stopped. The people demand it and it is absolutely necessary for the preservation of the fish life in waters of the state. The Fish and Game Commission will do all in its power to enforce the laws upon the statute books governing this subject, and it is the duty of the courts to see that the mandates of the law are carried out.

This, however, can not be done without the earnest assistance and co-operation of the several district attorneys throughout the state, who have in some instances failed to give the assistance which the importance of the subject demands.—Robert D. Duke.

HOW SAN FRANCISCO BACKS THE GAME LAWS.

There has been great improvement in the co-operation of the judges of this state in enforcing the fish and game laws. There are only a few places where it is still difficult to obtain convictions. One such place is San Francisco. Records compiled by the Fish and Game Commission show that during the last three years but twenty fines, and these for small amounts, have been imposed by the police courts of San Francisco on violators of the fish and game laws. During the same length of time, only five violators were sent to jail, while thirteen cases were dismissed and fifty-three convicted persons were let go with suspended sentences. The record also shows that a large percentage of those who were fined or jailed were Chinese. All but ten of the eighty-nine violators appearing in court were foreign born.

The record compiled is worthy of consideration. This commission does not expect the fishermen to be branded as felons or anything of that sort. It seeks from the courts in convictions, punishment which will deter the market fishermen from despoiling the fish supply. The law is not drastic. It aims to protect in a perfectly sane way the fish and game food supply of the state. When the commission presents evidence that warrants conviction, it stands to reason that if the convicted person is let off with a suspended sentence which means no punishment at all, the very purposes of the commission's work are hampered seriously.

If for profit market fishermen or game hunters are wilfully violating laws which they know exist, the Fish and Game Commission should be sustained in its endeavor to enforce these laws.

SAN DIEGO COUNTY NOW HAS TROUT FISHING.

The lack of year-round streams has driven San Diego County anglers to other localities in the past, but now all is changed. Cuyamaca Lake, bone dry in 1913, is now the scene of some of the best fishing in the state.

The results of the present trout season at Cuyamaca Lake clearly demonstrate the value of the hatchery work of the Fish and Game Commission. In 1915, 2500 trout sent from the State Hatchery were planted in the lake. This was

Fig. 76. Trout caught on opening day of season in Cuyamaca Lake, San Diego County. From left to right: Mr. Webb Toms with 3-pounder, Mr. Jack E. Thornton with 3 and 4 pounders, and Mrs. J. E. Thornton with 6½-pound rainbow, the largest catch of the day.

purely an experiment and the anticipated results were doubtful. Thousands of trout from the State Hatchery and some furnished from the exhibit of the United States Bureau of Fisheries at the Exposition have been added in the last two years. Now the fish crop is ready to be harvested. On the opening of the trout season in May, two limits were taken. One bag contained a six and one-half pound rainbow trout which was twenty-two inches long and seven inches wide and took twenty-five minutes to land. All other trout taken here have been steelhead, weighing from one and one-half to six pounds, and good catches have been made all during the season. The larger fish had roe nearly developed and the males contained milt. Since no schools of small fish have been found near the shore it is believed that the trout are spawning in the lake.

Cuyamaca Lake has been fed solely by rains and snows which drain into the basin. Due to dry winters, the lake became dry in 1913. Since that time a dam has been built and it is very unlikely that it will dry up again.

Due to effort on the part of anglers and intelligent and effective work of the State Hatcheries every county in the state may now boast of trout fishing. Ideal water and food conditions have produced splendid large fish within a short time, and Cuyamaca Lake will henceforth be a favorite camping place for San Diego anglers. These unlooked-for results have shown the efficacy of the state's method of augmenting the fish supply by propagating trout in hatcheries.

SQUIRREL CAMPAIGNS AND QUAIL.

Several complaints that quail had been poisoned in the squirrel campaigns being instituted in many counties have reached the Division of Rodent Control of the

State Commission of Horticulture. Mourning doves sometimes are victims of poison put out for squirrels, but there is little direct evidence that quail are poisoned. The government formula is being used almost exclusively, and the United States Public Health Service showed by a series of experiments that quail can take five or six times as much poisoned barley as a ground squirrel and show no effects. (See "The Effect of Strychnine Sulphate on California Valley Quail," Calif. Fish and Game, Vol. 2, pp. 11-13.) The experiments demonstrated that valley quail may be fed relatively large amounts of strychnine sulphate without toxic symptoms and that poisoned barley as used in ground squirrel eradication does not cause the death of California valley quail under natural feeding conditions.

RESEARCH PROBLEMS OF THE CALIFORNIA FISH AND GAME COMMISSION.

Although depending largely on the results of scientific investigations carried on by universities and professional investigators, the California Fish and Game Commission is actively engaged in solving some of the problems connected with the administration of fish and game resources. The greater the basis of fact the more sure is proper legislation. Facts suitable as a basis for legislation are obtained by careful research work. Some of the early experiments in tagging salmon and trout furnished dependable evidence as to the importance of these fish and furnished a splendid basis for legislation. Experiments carried out by the state hatcheries have greatly improved methods.

A summary of the investigations now under way will demonstrate the fact that the commission is attacking problems in a systematic and scientific way.

Department of Commercial Fisheries.

In order to solve problems connected with the fisheries, a trained investigator, Mr. Will F. Thompson, a graduate of Stanford University and formerly an official investigator for the British Columbia Fishery Department, has been employed. Mr. Thompson is devoting his full time to the solution of the problems connected with albacore and albacore fisheries. He has already been able to report that there is a correlation between temperature and the catches made. Much evidence as to spawning of this fish and the age as demonstrated by microscopical examination of the scales has been compiled. This investigator will next turn his attention to the herring and the herring industry. A full laboratory equipment has been furnished for this work.

Examination of many specimens of fish of different kinds to demonstrate the time of spawning has also been carried on by the department. Plans have also been made for some tagging experiments, so that the life history of the salmon may be better known.

Department of Fish Culture.

Although no definite investigations are now under way, the outcome of several fish transplanting experiments are being awaited with interest. Golden trout have been transplanted and it will be possible to demonstrate whether these brightly colored fish will change in coloration when changed to other localities. Other similar experiments dealing with steelhead trout have been instituted.

BUREAU OF EDUCATION, PUBLICITY AND RESEARCH.

A part of the time of the director of this bureau has been directed to the study of the food habits of birds. An investigation of the food habits of the roadrunner has been completed. The roadrunner has been accused by sportsmen of destroying nests and young of the valley quail. Eighty-three stomachs of roadrunners were examined, the contents tabulated, and a full report published. The last year has been devoted to the food habits of ducks in California. Hundreds of duck's stomachs have been examined and it will be possible to show which are the best food plants for attracting waterfowl.

In addition, studies have been made as to the relation of certain birds and animals to agriculture, and evidence on the breeding of ducks and other waterfowl has been collected. Information on the game birds and mammals of the state is being systematically collected and filed so that it will be available for further work.

WILD LIFE FILMS.

The wild-life films used in the educational work of the commission continue to be popular. There is sufficient demand to keep them busy most of the time. Many high schools are availing themselves of the opportunity to use these pictures. Organizations desiring to use these films this coming fall should secure dates immediately from H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

SHOOTING THE MOVIES.

The casual visitor to a shooting gallery displaying the sign, "Shooting the Movies," would be led to think that the old-time shooting gallery, with its moving array of ducks and deer, had been displaced by a regular moving picture, which gives a man a chance to shoot a real picture of the wild game which he shoots in the open. It is true that moving pictures of wild game now form the marks for the customers of a shooting gallery, but few persons realize the complicated electrical system needed to make this sort of shooting possible. A man shooting at objects in a moving picture would soon discover that almost before he pulled the trigger some other object would be in view. In order to make it possible to actually see where the animal has been hit, a complicated electrical system is necessary. The system is under Swiss patent and the controlling mechanism is a microphone. The report of the gun is recorded by the microphone, which in turn operates electrical devices which instantly stop the projecting machine, allowing the one shooting to see exactly where the animal is hit, and then automatically start the projecting machine again. The same system automatically changes the paper background of the picture, covering up the bullet hole and so prepares the target for the next shot.

At the beginning of the war the British Government became interested in developing some device for giving rifle practice to prospective soldiers. Fifty thousand pounds was set aside, and finally the electrical devices necessary to make "shooting the movies" possible were developed. Apparatus of this kind is now installed on the larger battleships, in aero stations and in training stations. Moving pictures of submarines and periscopes form the targets for those on board ship, whereas, soldiers going over the top often form the target at training camps.

The present apparatus has been perfected after eighteen months of work and is proving very satisfactory. Lubfin & Butler have opened a shooting gallery of this type on Market Street in San Francisco and the same firm expects to introduce this new sport in all of the larger cities of the West. Needless to say, this new sport develops the ability to shoot quickly and accurately.

NOT APPRECIATED HERE, SHAD ARE SHIPPED EAST.

The shad is one of our best food fishes, but only easterners appreciate the fact. We can buy a shad for twenty-five cents, which the easterner gladly pays one dollar or more to obtain.

No man may say why one fish finds a market, and another, and perhaps a better one, does not, but apparently in the case of the shad the reason it is not appreciated is that it is cheap. One hears the statement on all sides nowadays that fish food is so expensive people can not afford to eat it; and still they buy the expensive fishes when the cheaper ones are often (nay, usually) superior to them (the salmon always excepted). When our shad was not yet abundant it sold for from twenty to twenty-five cents a pound, and the demand was great. At this time money had about twice the purchasing power it has now. But before this the price was still higher, for it sold for a dollar and a dollar and a half a pound, and in some instances single fish brought ten and fifteen dollars! As the fish became more and more abundant the price dropped to ten, to five, and even to two cents a pound. At this price it became very unfashionable to eat shad.

You may argue that this does not bear out the assertion that if the shad was more expensive it would be better appreciated, for, you may say, it only shows that people have become tired of it. But on the Atlantic coast, where the shad came from, people have not tired of it. Quite the contrary. And now the point that proves the statement: From 80 to

90 per cent of our shad was shipped east last year, about 67 carloads in all, much of it going to the Atlantic seaboard, where the local supply was not great enough to supply the demand. There it sold at a price that commanded consideration and that placed it in a class of undoubted respectability. So this fish that we do not value appears, after a journey of over 2,000 miles, on the table of the epicure. Planked shad has been a tradition on the Atlantic coast since the time of George Washington, and anyone who may have been elected by the gods to eat planked shad at Marshall Hall, near Mount Vernon, will remember the occasion with reverence. It is commercially the most valuable food fish on the Atlantic coast.

We complain that the shad is bony. That is freely admitted. It is very bony, but it is just as bony when it arrives on the east coast, and people there are only too glad to remove the bones for the sake of the savory reward. It is not inconceivable that part of the flavor results from the trouble of removing the bones. That which comes without effort is usually not worth while. However, a little experience will teach one to remove the bones with very little trouble.

The shad passes most of its life in salt water, but annually migrates to fresh water for the purpose of spawning. It is during its migration up the rivers that it is caught, though a few are taken in the ocean. Little is known of its life in the ocean, and little is known of its food, for it eats scarcely at all while in the rivers. Furthermore, our shad does not naturally belong to the Pacific coast fauna. Several times between the years 1871 and 1880 young shad were shipped from the Atlantic coast and planted in the San Joaquin and Sacramento rivers. Now it is one of our abundant fishes.

The shad is doubly a cheap fish at present, for it is oily enough to require very little additional fat in cooking. But it will not remain a cheap fish when it is appreciated, for the supply will not stand a great demand here any more than it has on the Atlantic coast.

The shad season is now on. Let us keep for our own consumption this excellent fish. Sending our shad east is admitting that we lack epicurean education.

Try it baked: Season fish well with salt and pepper and sprinkle lightly with corn flour. Lay it on a flat baking dish and spread over it about a teaspoonful of oil or meat drippings. Bake in a brisk oven from 20 minutes to a half-hour, basting occasionally with a little milk and water, or with just water. Serve with lemon or tartar sauce. In a gas oven the fish may be placed under the flame and turned over.

COMMITTEE ON ZOOLOGICAL INVESTIGATIONS, CALIFORNIA STATE COUNCIL OF DEFENSE.

CHEAP FISH ARE OFTEN THE BEST.

With the exception of the salmon there is scarcely a fish that is expensive because it is good. The salmon is worth all that is asked for it at its highest price. It is not a cheap fish, nor should it be, for there is a market for every salmon that is caught, even if it never appeared in the fresh fish market.

Though people think of the sardine more as a canned fish, it is, if used fresh and fried, or broiled, or baked, one of our most delicious fishes. (Do not let the market-man sell you herring for sardines. The sardine usually has dark spots on the side, but not always. But it always has fine raised lines or ridges on the gill cover that extend downward and spread out fan-like.) In San Francisco the sardine may be had for five cents per pound, and it should be had that cheaply everywhere in the state where the demand is great enough to enable the dealer to order a 100-pound box at one time, for the fishermen receive less than a cent a pound for it (from $10 to $18 per ton).

The striped bass retails in San Francisco at five times the price asked for the sardine. Now, it is a dangerous thing to assert that one of two good fishes is the better, for tastes differ more perhaps in fish food than in other food. Some like a rich, fine-fleshed fish, while some prefer a drier, coarser fish; some like one flavor, some another. It is a case of Jack Sprat over again. The writer (and he is not alone in this opinion) would prefer the sardine even if the above prices were

reversed. But the supply of the striped bass is very much less than that of the sardine. Last year's catch of sardines exceeded a hundred millions of pounds on our California coast. Everyone knows the striped bass. It is a game fish that sportsmen pay good sums of money to go fishing for, and when people hear that the market-man has striped bass they think it must be a particularly good fish, for they have heard so much about it. When they learn the price they feel sure that it is the best. On account of this demand the fishermen received from ten to fifteen times as much for the striped bass as they do for the sardine.

Not only do we pay much more for such expensive fishes, but because we demand them we increase the price of the cheap fishes on account of more expensive waste. Figure it this way. A wholesale dealer pays $15 for 100 pounds of striped bass. He pays $1 for 100 pounds of sardines. He may lose sometimes on an off day as much as 25 per cent of his fish. Of course, this excessive waste is very unusual, but it will illustrate what we wish to say. Thus he loses $3.75 on his striped bass and 25 cents on his sardines, and as he has to average his loses to some extent the cheap fish have to bear more than their share of the burden and are no longer cheap fish.

To put it briefly, if we ate only the plentiful sorts of fishes the price could be made much less, for if the dealer did not have to handle the expensive sorts his loss would be less.

There are other cheap fishes besides the sardine that are good: the rex-sole, the shad, the sablefish, the mackerel and others. We have picked out the sardine to compare with the striped bass only because of its abundance. It should always remain a cheap fish.

COMMITTEE ON ZOOLOGICAL INVESTIGATIONS, CALIFORNIA STATE COUNCIL OF DEFENSE.

FEW ELK IN 1859.

The following interesting item relative to the killing of an elk in the vicinity of Stockton is doubtless of far greater interest to us at the present than it was to the readers of the "Stockton Argus" in 1859. It can be seen that even at this date the elk had become practically exterminated in the San Joaquin Valley. We are indebted to Mr. William Cohen for the item:

"An elk weighing some 425 pounds was brought to Stockton on 25th October from Middle River, where it was killed on Saturday last by Robert Dykman, the hunter, to whose superior skill with the rifle we are indebted for the larger portion of game of this description that finds its way into our market. Mr. Dykman was three days upon the trail, in which time he followed his game from near the mouth of the Mokelumne, across the San Joaquin and Middle River, a distance of about thirty-five miles. The horns were some six feet in length, with antlers, the longest of which were eighteen inches. The head and horns weighed 75 pounds, which were retained here, and the remainder shipped to San Francisco, where the scarcity of cervine provision commands for it a higher price than could be obtained in our own market.—*Stockton Argus*, October 25, 1859.

SALT FOR DEER.

Some salt bricks were furnished forest officers in Trinity County by the Commission in 1915. The deer made good use of this salt after they had become accustomed to the bricks. The forest officers who made this experiment, as well as others familiar with wild life, believe that much greater utilization of the salt would have resulted if ordinary loose salt had been provided. Salt in this form could be placed on logs by squaring off one side and boring two-inch auger holes five-sixths of an inch deep and filling these with salt. The salt logs might be cut where cattle do not ordinarily travel and additional safety would be furnished by the small holes from which salt cannot be licked so easily by a cow.

There is a real necessity for salting deer. It is, of course, well known and recognized that cattle absolutely must have salt to grow in weight and to remain healthful. As deer have always used licks, it is assumed that this method of salting is satisfactory.

One of the advantages of salting deer is that they do not have to leave the high feeding grounds to travel a long distance to some lick that is usually near a stream at some low elevation, with little feed in

the near vicinity. Other deer linger near the licks and usually are in poor condition because of the lack of feed.

In getting the small amount of salt in the licks, deer get a large quantity of earth which, if not injurious, is certainly not healthful. Licks are not in as good condition as they were before so many stock were grazed, for cattle trample all around and through the licks, mixing the salty deposits with the clay or other dirt. It appears certain that the deer, with their smaller feet and some instinct for continued use of the licks, make regular trails and keep the saline part of the licks more free from foreign matter. So far as hunting at licks is concerned, no more of this would be done at the artificial licks than at the natural licks. Salting deer is necessary, and the commission should furnish and distribute 2,000 pounds of salt annually in Trinity County.—E. V. JOTTER.

FAIR PLAY.

(A page of criticisms and answers.)

WANTS SALE OF TROUT.

San Francisco, June 1, 1918.

Mr. Carl Westerfeld,
Executive Secretary,
State Fish and Game Commission,
San Francisco, Cal.

My dear Mr. Westerfeld: I am in receipt of a communication from one Jack Lloyd of Pine Knot, Los Angeles County, who writes that there are thousands and thousands of big trout in Big Bear Lake which he says could be sold at reasonable rates in Los Angeles. Lloyd writes that there is no limit to the fish in the lake at the present time, and inasmuch as he has written me asking to know how this supply could be made available for the fresh market commercially, I am writing to you without comment, although I would be glad to have your opinion on the matter.

Yours very truly,
(Signed) F. N. BIGELOW,
Secretary.

SALE OF TROUT PROHIBITED.

San Francisco, June 4, 1918.

F. M. Bigelow, Esq.,
Sec. State Market Commission,
No. 606 Underwood Building,
San Francisco, Cal.

My dear Mr. Bigelow: Your letter dated June 1, advising me that you had received a communication from Jack Lloyd of Pine Knot stating that there are thousands and thousands of big trout in Big Bear Lake which could be sold at reasonable rates in Los Angeles, is now before me.

Jack Lloyd is a market fisherman. On October 19, 1917, he was convicted for having over the limit of trout in his possession and paid the fine of $25 imposed by the judge.

Big Bear Lake is an artificial lake in San Bernardino County, about eight miles long and a mile and a half wide. It was stocked with fish by the commission and is one of the favorite fishing grounds in southern California. From 50,000 to 100,000 tourists go there every year for recreation and sport, being attracted largely by the fishing. At the request of these people a bill was introduced at the last session of the legislature prohibiting the sale of trout. It had the unanimous support of the representatives from southern California, and after a most thorough discussion passed both houses of the legislature and was signed by the Governor.

At the time the bill was before the legislature I had the pleasure of hearing all the arguments, pro and con, and thoroughly agreed with those in favor of the bill, particularly in its relation to Bear Lake, which is a small lake and would in a short time be depleted of its fish if market fishing were permitted to continue, thus depriving many, many thousands of people of the only real good trout fishing to be had in southern California.

It seems that every market fisherman, commission merchant and profiteer has attempted to set aside the restrictions passed for the conservation of our fish and game. The best answer to those men

is Col. Roosevelt's message, which reads as follows:

"To the profiteering proposal of the pseudo-patriots, the patriots for revenue only, that protection of wild life in war time be relaxed, the united hosts of conservation reply:

"You Shall Not Pass.

"Let this be the slogan of every farmer, of all who dwell in the open, and of all who love nature and who wish to see our natural resources preserved for the perpetual use of our people and not destroyed for all time to gratify the greed of a moment."

Yours very truly,

(Signed) CARL WESTERFELD,
Executive Officer.

FACTS OF CURRENT INTEREST.

The enabling act of the Federal Migratory Bird Law was finally passed on June 6, 1918; the greatest piece of game protective legislation in the world is thus brought to completion.

✣ ✣ ✣

Two Austrian fishermen have been arrested in southern California under the Wood Act of August, 1917, for dumping overboard twenty tons of barracuda. Such wanton destruction of valuable food is now a criminal act.

✣ ✣ ✣

The site for the new Yosemite Hatchery has been selected and ground will be broken soon.

✣ ✣ ✣

On May 7, 1918, the Western California Fish Company of Pittsburg, California, secured a salmon weighing 67 pounds.

✣ ✣ ✣

The counties of Marin and Yolo each pay a bounty of $20 on coyotes and Solano and Sutter each pay $10.

✣ ✣ ✣

Paladini, the fish dealer so often accused of monopolizing the wholesale fish industry of San Francisco, has been arrested for shipping striped bass out of the state.

✣ ✣ ✣

The attempt to breed ducks for the market recently made by A. Schilling, has been abandoned. The large game farm near Newark, Alameda County, was the largest of its kind in the state.

✣ ✣ ✣

Striped bass have been plentiful this spring and have sold as low as seventeen cents per pound. The abundance is doubtless due to the added protection this fish has received the past three years.

✣ ✣ ✣

Large numbers of fish have died in the Kern River near Bakersfield, probably because of low water. Fortunately these fish were not valuable as food.

✣ ✣ ✣

The lowly jackrabbit has become so important a food item that the price has been increased in the markets.

✣ ✣ ✣

The shad catch this spring has been below normal due to overfishing the past few years.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

FRY DISTRIBUTION BEGINS.

On June 2, Fish Distribution Car No. 02 will leave Sisson on the first trip of the season. A consignment of 100,000 quinnat salmon fry will be shipped from Mt. Shasta Hatchery on this trip, consigned to H. E. Westbrook of Smith River. Delivery of the fish will be made at Grant's Pass, Oregon. From that point the shipment will be transported overland in auto trucks and planted in Smith River, Del Norte County, near Crescent City. Immediately upon the return of the car from Grant's Pass, the shipment of trout fry from Mt. Shasta Hatchery will be commenced. Car No. 02 has just returned from the Southern Pacific car shops at Sacramento, where it has been fitted up with a new type of gas engine and air compressor. This distribution car, which is a converted Southern Pacific baggage car, operated under lease to this commission for the season of 1918, is exceptionally well equipped for the season's distribution work, many important improvements having been made in the special aerating apparatus.

Distribution Car No. 01 is at the present time in the Southern Pacific shops at Sacramento, where it is being reconstructed. An entire new steel underframe was recently received from the East, and with extensive repairs to the trucks, roof and body of the car, repainting, etc., the car will be as good as new when completed. The engines and aerating apparatus, too, are to be given a thorough overhauling before the car is again put on the road. This work is all being rushed to completion, and it is expected that the car will be ready for operations by the middle or latter part of June. The first work undertaken by Car No. 01 this season will be to assist in the distribution of trout fry from Mt. Shasta Hatchery. Later on in the season it will in all probability be sent south to take up the distribution of fish in the waters of southern California from the Mt. Whitney Hatchery.

TAKE OF EGGS BELOW NORMAL.

Owing to the extreme drought this season the take of both rainbow and steelhead trout eggs was considerably short of our expectations. Every effort was made to obtain a greater number of trout eggs than ever before, but despite out utmost endeavors only between sixteen and seventeen millions of eggs of all species were obtained. On some of the streams where our egg-collecting stations are located the flow of water became so low during the latter part of April that all egg-collecting operations were discontinued before the first of May, whereas, in normal years, operations are carried on until very near the first of June. This condition was especially noticeable at the Snow Mountain Station on the Eel River, Mendocino County, where steelhead trout eggs are taken. The water in the river fell so rapidly and became so low during the closing days of April that it was only by exercising the greatest care and working night and day that the hundreds of thousands of steelhead eggs being "eyed," in preparation for shipment to other stations, were saved. Other stations affected by the extreme drought were: Scott Creek Station in Santa Cruz County, the Klamath stations at Bogus Creek and Camp Creek in Siskiyou County, Almanor and Domingo Springs stations in Plumas County, and Tallac Station, El Dorado County. Had it not been for the preparations made for obtaining a record take of eggs this season, fishcultural operations for the year 1918 would undoubtedly have been a failure. As a result, however, of our extensive operations we will be enabled to distribute in the waters of the state in the neighborhood of sixteen million trout fry, and this number, under the circumstances, will be made to fill all requirements.

BROOKDALE HATCHERY.

The distribution of trout fry from Brookdale Hatchery has been commenced, and by the middle of June the streams of Santa Cruz County will have

been well stocked with fish. Following the Santa Cruz County distribution work, the streams of Santa Clara County will be taken care of by the Brookdale Hatchery. Owing to the fact that there is grave danger of the water supply giving out if operations are continued much beyond the fore part of July, it is essential that the distribution work from Brookdale Hatchery be rushed to completion at an early date.

UKIAH AND FORT SEWARD HATCHERIES.

Ukiah and Fort Seward hatcheries will commence distributing fish in the streams of the north coast counties during the fore part of June. At these stations also it will be necessary that the distribution work be completed before the water supply becomes too low.

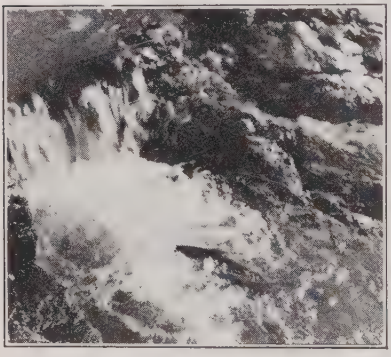

Fig. 77. Trout ascending fish ladder of Snow Mountain Dam, in Mendocino County. The Snow Mountain egg-collecting station is situated near by. Photograph by S. Campbell, April, 1918.

ALMANOR HATCHERY.

Almanor Hatchery distribution operations will be commenced in the near future, and by the fore part of July the planting of fish from Domingo Springs Station will be under way.

FEATHER RIVER HATCHERY.

A new hatchery has been constructed on Gray Eagle Creek near the town of Blairsden, Plumas County, on the line of the Western Pacific Railroad. From this station trout fry will be shipped to supply the applicants of Plumas, Modoc and that portion of Lassen County, along the line of the Nevada, California and Oregon Railway. This station, which will be known as the Feather River Hatchery, is at present only a temporary structure. If conditions prove to be favorable for fishcultural operations, a permanent hatchery will be constructed next season.

BEAR LAKE HATCHERY.

Bear Lake Station is fulfilling all expectations. Even under adverse weather conditions obtaining, this season's results have been most satisfactory. With the improved facilities at North Creek Station we were enabled to obtain in excess of three million rainbow trout eggs. A considerable number of eggs, after being "eyed," were shipped to Mt. Whitney and Mt. Shasta hatcheries, where they will be hatched, reared and distributed in the waters of the state. In excess of one million of the eggs will be hatched and reared at North Creek Station and at the main hatchery near Green Spot Springs, for liberation in the streams of San Bernardino County and Big Bear Lake.

MOUNT WHITNEY HATCHERY.

The results of the extensive improvement work recently commenced at the Mt. Whitney Hatchery are beginning to show. The large pond is nearly finished, and the work on the grounds is progressing nicely. The fish hatched from Eastern brook and Loch Leven eggs shipped to this station during the early spring months are thriving well and are about ready for distribution. The steelhead trout fry hatched from eggs shipped from the Snow Mountain Station are also doing well.

WAWONA HATCHERY.

All repairs to the building, flumes, tank, etc., at Wawona Hatchery have been completed. On May 12, consignments of rainbow and steelhead trout eggs were received at Wawona from Mt. Shasta and Brookdale hatcheries. The resulting fry will be distributed in the streams in and around Wawona, as in former seasons.

TAHOE HATCHERIES.

Egg-collecting operations at Mt. Tallac Hatchery have been nearly up to normal

this season, and the usual number of black-spotted trout fry will be distributed in the streams tributary to Lake Tahoe from the Mt. Tallac and Tahoe City hatcheries. Consignments of black-spotted eggs for distribution in other sections of the state will also be shipped from Mt. Tallac Hatchery to Mt. Shasta and Mt. Whitney hatcheries.

LADDERS AND SCREENS.

Reports have been received to the effect that a fish ladder has been installed over the Huseman Dam, the property of the Lucerne Water Company, near Granada, Siskiyou County. This is one of the dams for which plans and specifications for a fish ladder were furnished during the early spring months. It has also been reported that an open cut, to enable fish to pass the dam, has been constructed in the Spaulding Dam in Little Shasta River, Siskiyou County. This dam is the property of the Spaulding Mill.

Reports from Shasta, Tehama, Modoc and San Bernardino counties indicate that screens are being installed in a great many irrigating power ditches and canals, in accordance with our instructions. Screen surveys were recently made in Lake County, and we have been assured that the screens will be installed as soon as materials can be obtained for their construction. Among the more important automatic cleaning screens recently installed are those of: Bert Hampton, near Mineral, Tehama County; R. W. Haynes, Burney, Shasta County; R. L. Johnston, Montgomery Creek, Shasta County; P. Bertagna, Montgomery Creek, Shasta County; Pacific Improvement Company, Castle Crags, Shasta County; W. L. Williams, Chromite, Shasta County; and Mrs. R. McKay, Red Bluff, Tehama County. The work on the large screens for the Stanford University Vina Ranch in Tehama County is being rushed, and within a very short time these screens should be ready for installation. The largest rotary screen ever constructed in the state was completed about a month ago. It was installed by the Anderson-Cottonwood Irrigation District at the intake of their canal, near Anderson, Shasta County. The screen is in three sections, each 9 feet wide by 12 feet 5 inches in diameter, and is of the southern California Edison type. A recent inspection was made of this screen, and it was found to be working perfectly.

COMMERCIAL FISHERY NOTES.

N. B. SCOFIELD, Editor.

KELP AND POTASH MANUFACTURE.

During the year 1917 the following kelp companies operated in California:

Diamond Match Company
Hercules Powder Company
Lorned Manufacturing Company
Pacific Products Company
Occidental Chemical Company
San Diego Kelp Ash Company
Sea Products Company
Swift & Company Kelp Works

Besides these companies several outfits known as "handpickers" operated along the southern California coast. Their method of operation is to go out in boats and cut the kelp by hand and pull it in over the side of the boat or load it into small barges. The kelp is then taken ashore where it is scattered on the grass to dry. When it is sufficiently dried it is burned in an open kiln. The resulting ash is sacked and sold to the larger companies who refine it to extract the potash and other salts and by-products, or else it is shipped direct to refineries in the eastern United States. It takes twenty tons of wet kelp to make one ton of ash and the ash contains between eight and ten per cent of pure potash.

A few of the larger companies and the United States experimental plant at Summerland have chemists and chemical engineers employed who are endeavoring to devise more economical means of extracting the potash salts as well as developing by-products; the object being to make it profitable to continue the operation of the plants when the price of potash shrinks to near what it was before the war. So far the best results in the way of developing by-products are being obtained in the fermentation process

such as is employed by the Hercules Company at San Diego. One of the most likely leads on which they are working is the development from the celulose of the kelp of a base for the non-inflammable shellac which is used for aeroplanes and non-inflammable motion picture films.

The company feels confident that it will be able to continue the San Diego plant after potash has shrunk to its pre-war price. The companies believe that more economical methods of refining of the potash salts will be developed as they gain in experience and cite as an example the wonderful progress that has been made in the process of sugar refining.

At the beginning of the kelp industry there was much prejudice against the cutting of the kelp beds, for it was believed by many that the beds were the spawning places of many varieties of fish and that it the beds were cut the kelp would be destroyed and thus not only would the fish be destroyed for the want of a spawning place but the beaches would be deprived of the protection the beds afford against the high waves. It has been found that the kelp is not destroyed by cutting and

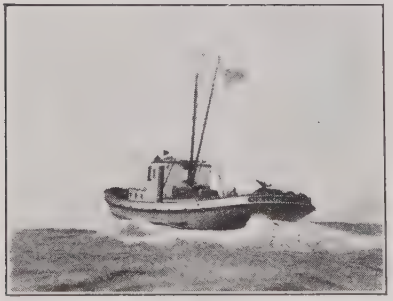

Fig. 78. New patrol boat "Albacore" under way. Photograph by H. B. Nidever.

that it regrows within ninety days. Even after the most severe cutting, which takes off the tops of the kelp spread out on the surface of the water, enough tops remain intact to still offer a good refuge for fish and to protect the beaches against the action of waves. It has been found through the investigations of the United States Bureau of Fisheries and the Scripps Institution that cutting the kelp does not destroy the fishes spawn. In fact, no spawn of any fish has been found on the kelp which is harvested.

Some complaint has also been made of the odor of the kelp at the factories during the process of incineration. The odor, which is not unlike that of roasting coffee, has been mostly overcome by passing the gases again through the fire and thence through condensing rooms and sprays of water.

FISHERY STATISTICS.

In order that the statistics of the fisheries, which the Fish and Game Commission has been gathering during the past three years, may be more complete and accurate, a new system is being employed. The present law requires that packers and dealers receiving fish from fishermen make monthly reports to the Fish and Game Commission of the amount of each variety of fish received. They are also required to issue reecipts to each fisherman from whom fish are received and to keep a carbon copy of the receipt which must be kept at least six months for the inspection of the commission.

It is extremely valuable from a conservation standpoint that accurate records of individual boat catches be kept. It has proved to be of importance also to the Food Administration that individual boat records in certain fisheries be kept. The Fish and Game Commission therefore has undertaken to furnish the Food Administration with this needed information. Each packer and dealer now is furnished receipt books in triplicate to be used when receiving fish. One carbon copy will be for the use of the Fish and Game Commission. From these receipts will be compiled the monthly records of the quantity of each variety of fish taken in the state. The Food Administration will be furnished with data as to prices paid, to whom fishermen under contract are delivering fish, and the average yearly catch of boats in any fishery. By using these books the packers and dealers will be relieved of the trouble of making out the monthly fish report which has been required and also the weekly report of receipts from individual boats now required by the Food Administration in certain of the fisheries. Not only will the dealer and packer be benefited and the Food Administration receive the information it requires, but the Fish and Game Commission will be getting a system of statistics more complete and accurate than

that of Scotland which leads all other countries in statistical fisheries conservation work. The record of individual boat catches such as will be gathered each year will be priceless in determining the trend of the fisheries and will be conclusive evidence whether any fishery is or is not being depleted.

INCREASE WORKING FORCE.

To gather the fisheries statistics necessary for the conservation of the fisheries and to compile the data desired by the Food Administration, the Fish and Game Commission has employed two extra men, one to be located at San Francisco and the other at San Pedro Harbor. To facilitate this work and to keep in better touch with the already extensive and rapidly growing fisheries of Southern California, the Fish and Game Commission has established an office on Fishermen's Wharf, San Pedro, where the statistical files for that part of the state will be kept and tabulated. The office will also be a headquarters where information may be obtained by fishermen or anyone else interested in the fishing or kelp industries. A laboratory is also being fitted up in connection with the office to be used by the commission's fisheries investigators.

CONSERVATION IN OTHER STATES.

BEAVER WANTED IN MICHIGAN.

Even the State of Michigan, which was once noted for its colonies of beavers, realizes the fact that she must re-colonize these animals. Conservationists are urging the stocking of tributary creeks flowing through sand plains, on the plea that these animals would cause no hardship on agriculturalists. The beaver is pointed out as the only fur-bearing animal that does not prey on other forms of wild life.

MINNESOTA HELPS IN GOVERNMENT'S "EAT MORE FISH" CAMPAIGN.

As a part of the campaign of the United States Bureau of Fisheries, designed to get people to eat more fish, the State of Minnesota is conducting demonstrations of the cooking of the coarser fishes, such as the carp, bowfin (dogfish) and buffalofish. Two different parties are now touring the state. Work of this kind has proved of great value in Illinois and other states.

MARYLAND TO HATCH STRIPED BASS.

Maryland is constructing and equipping two fish hatcheries. One of them for the tidewater work is to be a floating hatchery.

This hatchery will be equipped to propagate white perch, yellow perch, shad and herring and it is also proposed to try out the propagation of rockfish or striped bass.

NEW YORK ENFORCES FISH AND GAME LAWS.

The New Yo k Conservation Commission, headed by George D. Pratt, is enforcing the fish and game laws. Of the 243 cases reported for August, 1917, 202 were settled in civil actions, and $4,443.72 was recovered in fines. Even frogs are protected in New York, and the one violation of the law reported was settled in court and a fine of $21.00 was collected. Violations of the law protecting fur-bearing mammals netted $39.00, and the six cases brought into court having to do with the protection of song birds resulted in fines amounting to $185.40.

WASHINGTON GAME FARM.

The Washington Fish and Game Commission is trying out the experiment of placing the game farm at the state penitentiary, and utilizing convict labor. The experiment will be watched with interest.

AUTO HUNTING STOPPED IN NEW JERSEY.

A law making it illegal to kill or pursue birds or animals by the aid or use of an automobile is now in effect in New Jersey. The penalty for violation of the act is $50 for each offense.

Provisions of the anti-automobile hunting law are very specific. They make it unlawful for any person or persons while in an automobile to hunt for, pursue, shoot, shoot at, kill, capture, injure or destroy any bird or animal in this state,

or to use any light or lights carried on or attached to any automobile for any purpose whatsoever in hunting.—Sportsmen's Review Mar. 23, '18.

PENNSYLVANIA WILL PROTECT RUFFED GROUSE.

A petition by which counties can be closed against the shooting of ruffed grouse, is being sent by the Pennsylvania Game Commission to sportsmen and hunting clubs throughout Pennsylvania.

Ruffed grouse, or pheasants, are becoming alarmingly scarce in various sections of the nation and sportsmen in Pennsylvania are insisting that the season for grouse must be closed for a period if this, the greatest of American game birds, is to be preserved from extinction. Unfortunately these birds can not be purchased in either the United States or Canada. Therefore drastic steps must be taken if the grouse are to be saved.

Already about a dozen counties have closed the season for one or two years and the petition is circulated in the hope that all the counties will act simultaneously to protect the bird for two years.

LIFE HISTORY NOTES.

LIONESS TRACKED TO LAIR.

On April 24, 1918, I made a trip up the mountain side northeast of Wawona looking for lion signs and found the tracks of a female mountain lion (*Felis concolor*). The tracks were about two days old. My dogs cold trailed her until it began to rain heavily, which destroyed the scent, so I was compelled to give her up for that day. I was convinced that the lioness had young in some of the bluffs in that vicinity so started early the next morning to hunt the bluffs and about seven o'clock the dogs picked up the trail of the lioness which was then about twelve hours old. After trailing about three hours, during which time the lioness had made several unsuccessful attempts to kill a deer, the trail finally led to the carcass of a doe which was partly devoured as it had been killed several days earlier (see fig. 80). From here the lioness went up the mountain, circling round a bluff of rocks. On the upper side, atop of the bluff, the trail apparently ended for the lioness had jumped down over a ledge and

Fig. 79. Site of the lair of mountain lion near Wawona, California. Photograph by Jay C. Bruce.

worked down the bluff to her lair (see fig 79). After circling for about ten minutes without locating the trail the dogs winded the lair and soon located it. The mother lion was in the lair with the three kittens.

After some difficulty I succeeded in shooting the mother lion in her lair and then captured the three kittens which were about ten days old, I should judge.

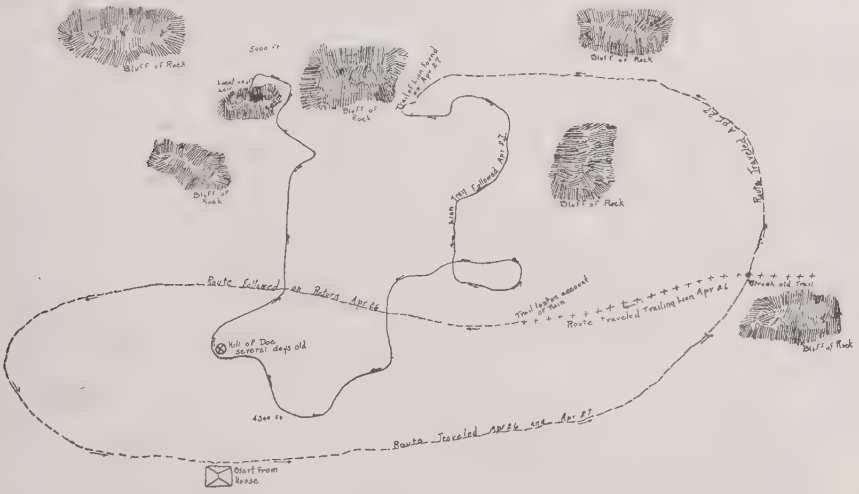

Fig. 80. Diagram showing location mountain lion lair and route followed by hunter and lion.

The lair was about six feet long and two feet wide. The nest was bedded with pine needles, probably carried in the den by wood rats for their nests at some time. There was also a small opening, perhaps eight inches in diameter, through which the sun would shine on the kittens in the nest.—JAY C. BRUCE.

Fig. 81. Mountain lion kitten captured by J. C. Bruce near Wawona, California, on April 27, 1918. Photograph by Jay C. Bruce.

QUAIL SUFFERED FROM LACK OF FOOD.

During the severe snow storm in January, 1916, great numbers of quail died in Modoc County, either from lack of food or lack of shelter. Ranger Snelling placed large quantities of wheat near all the warm springs in Pitt River Canyon where the snow had fallen to a depth of thirty-six feet. The quail, after devouring the food set for them, would seek shelter under roots and brush and even in the holes of small animals, where they very often died during the night. The snow would become so packed that the birds were unable to come out of their resting places and would be smothered. Consequently, it was seen that not only food, but also shelter must be provided for the quail during heavy storms. The numbers of birds dwindled from three hundred and fifty first seen at the feeding places, to nineteen, the number finally captured with traps. The captured birds were fed and kept in a warm place for about a month when they were given their liberty. These quail returned again and again to the old feeding places.—G. W. COURTRIGHT.

AN EMPEROR GOOSE TAKEN IN GLENN COUNTY.

On Sunday, December 2, 1917, I saw in a string of ducks killed by a Los Banos hunter a fulvous tree-duck. I believe

this is a rather late date for this bird to be found in that section.

I was recently advised by Dr. B. A. Mardis of San Francisco, California, that he killed an emperor goose near Norman, Glenn County, California, during the fall of 1916. This bird is now on display in the store rooms of the Ellery Arms Company.—J. S. HUNTER.

VALLEY QUAIL LAYS TWENTY-NINE EGGS.

Those who are endeavoring to rear valley quail in captivity will be interested in the following results obtained in the past breeding season. A valley quail which I have kept in captivity for several years deposited her first egg on March 2 and the last one on May 16, making a total of twenty-nine eggs. She showed no inclination to incubate them so it has been necessary to hatch them under bantam hens. A still larger number of eggs for breeding purposes could doubtless have been obtained had the eggs been removed as they were laid.—GEORGE NEALE.

THE BARN OWL AS A GOPHER CATCHER.

Direct evidence of the value of the barn owl is to be found in an experiment performed on the ranch of Mr. Burris, near Hanford, Kings County, California. A young barn owl was taken from the nest and placed where the parent birds could feed it. On the dates indicated the fresh food in view around the young bird was as follows:

May 14th, 6 gophers and 1 jack rabbit.
May 15th, 5 gophers.
May 16th, 1 gopher and 1 jack rabbit.
May 17th, 2 gophers.
May 18th, 4 gophers.
May 19th, 2 gophers.

Thus, a total of 20 gophers and 2 jack rabbits were killed in six days time by one pair of barn owls. In addition the parents fed themselves and another young owl left in the nest.—E. W. SMALLEY.

UNITED STATES FOREST SERVICE CO-OPERATION.

PEOPLE FAVOR ANGELES GAME REFUGES.

People are in favor of the two refuges of approximately 600,000 acres within the Angeles Forest, known as 4-A and 4-B. Deer are becoming more and more plentiful. We have approximately 400,000 people go into the forest each year for recreational purposes, and if there are 1,000 deer hunters, it stands to reason that the opposition of 399,000 should outweigh that of 1,000. If anyone is benefited by reason of an open season, it would be the resort owners, and yet with the possible exception of one owner, a man who has been in court several times for alleged game violations, I have yet to find a resort owner who is not in favor of the continuance of the game refuges.—B. W. CHARLETON.

ELK INCREASING IN SHASTA NATIONAL FOREST.

The elk in the Squaw Creek District are increasing. Seven cow elks with calves were seen this year (1917). Some of the original herd died off but they seem to be increasing now and are apparently acclimated. All elk seen were in good condition and apparently doing well.—WM. GRACEY.

GAME SCARCE IN EL DORADO NATIONAL FOREST.

Game is becoming so scarce in the El Dorado National Forest that the consensus of opinion of forest officers is that closed seasons should be enforced as follows:

Deer ---------- 3 years.
Grouse ---------- 3 years.
Gray Squirrels ---------- 3 years.
Quail ---------- 3 years.

—E. L. SCOTT.

GROUSE IN THE PLUMAS NATIONAL FOREST.

Grouse are noted in most parts of the Plumas National Forest, but the number is small. Sage-hen are only seen in Frenchman Creek, and a few in Sierra Valley. It is my opinion that the season on both these game birds should be closed for a number of years, and this same opinion has been voiced by a num-

ber of residents of this locality.—A. G. Barrett.

DESTRUCTION OF GAME BY PREDATORY ANIMALS.

Mountain lions are getting very numerous in District 2-21, the southern edge of which borders on the Yosemite National Park, which forms an ideal breeding ground for them, since no hunting or trapping is allowed, and dogs are prohibited as well. Ranger Elliott states that he had noted several instances where deer have been killed by these animals. Gordon McGrue, a trapper who winters in the high country, reports finding the carcasses of five deer which were killed by one lion. He has attempted to trap or poison the lion, but so far has been unsuccessful. Ranger Fowler also reports that he found four carcasses of deer killed by lions. The cases mentioned, which were reported by only three men, would show that lions are about the most serious problem to contend with when the whole forest is considered. We know that four were killed in District 3 and four in District 2 within the last year, although it is quite probable that several more were caught during this time.—Ernestt Bach.

BEARS NUMEROUS IN SHASTA NATIONAL FOREST.

About thirty-five bears were killed in the country between the McCloud River and Kosh Creek in the Shasta National Forest during 1916. Thirty coyotes and ten lions are also reported as being killed in this section during December of the same year.—W. M. Gracey.

THE FISHER IN THE TRINITY NATIONAL FOREST.

Fisher usually inhabit the higher, heavily timbered slopes and are seldom found at lower elevations except during the winter months when the country is covered with snow. It is thought that their food consists chiefly of field mice, gophers, tree squirrels and other small bird and animal life. On New River a settler is attempting to raise fisher in captivity, but so far has had only indifferent success. It is estimated that twenty to twenty-five fisher are taken each year on the Trinity National Forest, although the species is becoming more rare.—F. V. Jotter.

WILD LIFE IN RELATION TO AGRICULTURE.

MOUNTAIN RATS INJURE YOUNG TREES.

Forest Examiner Munns of the United States Forest Service has made an interesting study of the damage done by pack rats to young pine growth on the Angeles Forest. In one locality where the rats were numerous it was discovered that 43 per cent of the young trees have been severely injured or killed by these animals. The rats seem to work chiefly during the late summer and fall and usually more in a dry season than in a wet one. Mr. Munns concludes from this that the rats, which often have no access to water, tear off the tender bark in search of moisture. —*Weekly Bulletin of Forest Service*, Dec. 23, 1916.

IT PAYS TO DESTROY GROUND SQUIRRELS.

A word in regard to the economy of the ground squirrel eradication is at the present peculiarly appropriate, at a time when such stress is being laid on the conservation of the country's agricultural resources. During the past year it was estimated that squirrels on Union Island, in San Joaquin County, caused a damage to crops amounting to $65,000. An expenditure of $10,000 would practically completely free this land of squirrels and $1,000 a year thereafter would insure continued freedom. Surely it is more important to eradicate such a damaging pest from land now under cultivation than to cultivate even very large tracts of now uncultivated lands.—*Cal. State Bd. of Health Month. Bull. 12*, p. 321.

CALIFORNIA FISHERY PRODUCTS—JANUARY, FEBRUARY, MARCH, 1918.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Tehama, Glenn, Colusa, Sutter	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Totals	Mexico
Albacore												63,278				63,278	1,527
Anchovy										91,285						91,285	
Barracuda								4,912	15,284			71,411		451,492		543,099	136,840
Bonito												7,710		13,286		20,996	4,004
Bocaccio								15,363	72,701	371,601						459,665	
Bluefish								5,663	320	7,256						13,239	
Chilipepper								49,557	56,587	5,506						111,650	
Carp		14,834	8,250	2,298	8,087	11,918	35,153	3,403				52,529				126,472	
Catfish		73,168		2,383	1,966	15,573	11,393	912								105,395	
Coalfish								70,657		7,935	150	2,149	161			81,052	
Cultus cod	82							134,417	8,543	132,736						275,778	
Dogfish								167,131		5,075		9,611		1,495		183,312	
Flounder	10,129		99		981		51	193,291		69		4,930		1,120		210,670	
Halibut	60							20,380	653	880	56,530	436,149	2,304	550,727		1,067,683	186,970
Hake								12,422	3,575	8		1,533		2,359		19,897	1,113
Hardhead				7,195		7,205										14,400	
Herring	4,078		3,005,320					4,591,998	5,900							7,607,296	
Kingfish			10					5,400	19,769	14,837		278,006		9,714		327,736	
Mackerel										165,221		538,187	1,001	62,708		767,117	13,343
Mullet															64,467	64,467	
Pike			1,285	433	204	717	4,573	172								7,384	
Pompano								228		246		7,232				7,706	
Perch	8,975	258	38,897				15	5,315	2,356	3,844		2,505	15			62,180	
Rock bass												55,386		6,736		62,122	
Rockfish	2,852							372,865	185,417	335,618	68,638	837,208	15,324	562,414		2,380,336	855
Sole			36					1,291,294	283,335	94,674	9,955	43,230	138	2,463		1,725,125	
Salmon		1,273	2,253	6,750	75,334	29,191	80,384	6,618	337	320,630						522,770	
Smelt	744		3,766					33,786	3,141	3,766	2,675	34,439	2,753	21,743		106,813	
Sea bass (white)										136	40	18,534		5,370		24,080	
Sea bass (black)												7,732		11,445		19,177	1,310
Sand dab								427,646	36,992	1,717		6,203				472,558	
Striped bass			19,955	746	132,228	47,512	256,788	11,846	31							469,104	
Shad			1,639		14,537	1,338	30,767	595								48,876	

Splittail				3,652		2,877	1,115									7,644		
Sucker						4,525										4,525		
Sardine		240	451							9,294,110		30,474,902		1,657,219		41,426,922		
Skate								101,159		729		3,564	28			105,480		
Sculpin								165				7,679				7,844		
Tom cod								4,592				510				5,102		
Trout (lake)								265	1,151					47		1,463		
Trout (steelhead)			431													431		
Turbot			250				10				525	40				825		
Whitebait			4,569													4,569		
Yellowtail									43,524	22,491		48,874		116,356		231,245	40,404	
Miscellaneous			102	3,251		1,315		7,982	230	1,907		6,769		5,812		27,368	160	
Totals	26,920	89,773	3,087,313	26,708	233,337	122,171	420,249	7,540,034	739,846	10,882,277	138,513	33,020,300	21,724	3,482,506	64,467	59,896,138	386,526	
Crustaceans—																		
Crab (dozen)	1,802							36,940	454	95						39,291		
Spiny lobster											14,673	20,826	1,529	55,113		88,249	188,265	
Shrimp								58,012								58,012		
Mollusks—																		
Squid										16,083		29,677		13,912		59,672		
Cuttlefish								6,182	3,846	4,252		53				14,333		
Clam (Pismo)											175,604					175,604		
Clam (cockle)			2,954								60	8,852				11,866		
Clam (softshell)		3,158	29,170				25,736									58,064		
Clam (mixed)	9,295	540	33,044					200	252			7,662				50,993		
Oyster (shell) No.			14,220					746,650								760,870		
Abalones										71,988	12,452					84,440		
Mussels	560		169					1,758	4,270	100	6,431	12,183		480		25,951		
Snails												661				661		
Reptiles—																		
Terrapin		511														511		
Sea turtle														835		835	10,042	

VIOLATIONS OF FISH AND GAME LAWS.

February 1 to June 1, 1918.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without license	12	$195 00
Trapping without license	2	15 00
Spike buck, killing	1	
Deer meat, close season, possession	7	100 00
Trailing deer, close season	3	50 00
Illegal deer hides, possession	2	
Ducks, close season, killing or possession	4	75 00
Quail, close season, killing or possession, sale	4	105 00
Geese, close season, killing or possession	6	125 00
Cottontail rabbits, close season, killing or possession	4	75 00
Wild pigeon, close season, killing or possession	1	25 00
Wild pheasant, killing	1	50 00
Tree squirrels, close season, killing or possession	3	
Nongame birds, killing or possession	4	45 00
Total game violations	54	$860 00
Fish.		
Angling without license	27	$477 50
Fishing for profit without license	7	85 00
Making false statement on application for license	2	50 00
Trout, close season, taking or possession	18	375 00
Trout, excess bag limit	8	200 00
Trout, taking other than by hook and line	13	300 00
Trout, shipping by parcel post	1	
Striped bass, undersize, taking or possession	3	50 00
Black bass, close season, taking or possession	1	
Catfish, undersize, offering for sale	3	60 00
Sturgeon, possession, offering for sale	1	
Young of fish in possession	3	20 00
Salt water eels, undersize, taking or possession	3	100 00
Abalones, close season, undersize, taking or possession	17	390 00
Crabs, female, undersize, shipping from Humboldt Bay	8	120 00
Clams, undersize, excess bag limit	8	170 00
Illegal fishing apparatus	13	645 00
Dynamiting fish	2	400 00
Total fish violations	138	$3,442 50
Grand total fish and game violations	192	$4,302 50

SEIZURES—FISH, GAME AND ILLEGALLY USED FISHING APPARATUS.

February 1 to June 1, 1918.

Game.

Ducks	137	
Geese	8	
Quail	1	
Cottontail rabbits	5	
Tree squirrels	6	
Deer meat	178	pounds
Deer hides	24	
Deer feet	52	
Spike buck head	1	
Tree squirrel skins	41	

Fish.

Trout	439	pounds
Striped bass	513	pounds
Black bass	6	pounds
Salmon	69	pounds
Sturgeon	123	pounds
Catfish	12½	pounds
Salt water eels	62	
Abalones	315	
Crabs	330	
Crabs (cooked)	30	
Clams	1,537	
Lobsters	25	
Cockle clams	606½	pounds
Nets, traps and fishing outfits	5	

Searches.

Illegal fish and game	80

STATEMENT OF EXPENDITURES—YEAR 1918.

Item of expense	January	February	March	April
General administration	$1,950 09	$1,887 21	$1,782 56	$1,930 33
Research, publicity and education (game)	233 61	287 50	258 95	320 25
Printing	760 23	395 42	37 52	662 00
Fish exhibits	62 03			
Game exhibits				
Game farm	173 80	305 25	251 70	214 54
Mountain lion bounties	660 00	280 00	860 00	640 00
Lithographing hunting licenses				
Lithographing angling licenses				
Hunting license commissions	1,816 60	953 40	1,150 20	776 30
Angling license commissions	1,093 30	228 60	644 20	339 90
Market fishing license commissions	16 50	8 00	155 00	151 50
Paper Mill Creek Dam				
Totals	$6,766 16	$4,345 38	$5,140 13	$5,034 82
San Francisco district	$5,290 61	$5,320 48	$5,381 34	$5,624 48
Sacramento district	3,565 89	3,454 18	3,456 16	3,703 06
Los Angeles district	2,431 66	2,257 14	2,393 67	2,619 80
Launch patrol	642 27	1,109 52	1,086 10	1,217 53
Prosecutions (fish and game)	374 75	43 95	146 70	197 45
Crawfish inspection				
Winter game feeding				
Accident and death claims	250 80	539 29	212 50	124 04
Totals	$12,555 98	$12,724 56	$12,676 47	$13,486 36
Hatchery administration	$796 33	$816 90	$884 08	$933 97
Mount Shasta Hatchery	2,117 19	1,940 11	1,286 75	1,283 13
Klamath Station	227 25	423 30	316 10	514 75
Mount Whitney Hatchery	622 97	693 97	1,151 49	2,350 20
Rae Lakes Station				
Cottonwood Lakes Station				
Tahoe Hatchery	2,005 00	12 10	13 90	5 00
Tallac Hatchery	5 00	5 00	265 46	371 22
Fort Seward Hatchery	291 55	237 54	233 78	404 51
Ukiah Hatchery	23 63	20 78		100 42
Snow Mountain Station	398 79	383 96	355 16	297 62
Brookdale Hatchery	174 73	288 20	141 70	224 91
Scott Creek Station	31 00	28 00	78 10	101 00
Almanor Station	5 00	7 30	50 75	255 70
Domingo Springs Station	13 50		205 00	116 08
Bear Lake Hatchery	1 11	24 38	343 74	445 71
Wawona Hatchery				
Fish distribution	26 15	9 25	229 29	316 45
Fish transplantation	41 10			18 00
Screen, fishway and water pollution	599 70	625 93	714 72	664 09
Special field investigations				
Totals	$7,380 00	$5,516 72	$6,270 02	$8,402 76
Feather River Hatchery				$376 06
Fishery research and patrol	$1,335 29	$1,282 83	$1,333 92	1,517 64
Grand totals	$28,037 43	$23,869 49	$25,420 54	$28,817 64
Department of Engineering, launch "Albacore"	2,872 30			

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